PCT/GB 2003 / 0 0 2 8 6 4

10/519922

10 Rec'd PCT/PTO 03 JAN 2005

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

01 AUG 2003

WIPO PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed R. Mahoney

Dated 22 July 2003

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH
RULE 17.1(a) OR (b)

Patents Form 1/77

Patents Act 1977
(Rule 16)

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

THE PATENT OFFICE
03 JUL 2002
RECEIVED BY HAND

1/77

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — RJW/CP6059901

2. Patent application number *(The Patent Office will fill in this part)* — 0215383.1
03 JUL 2002

04JUL02 E730714-1 D02823
P01/7700 0.00-0215383.1

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
Patents ADP number *(if you know it)*

ASTEX TECHNOLOGY LIMITED
250 Cambridge Science Park
Milton Road
CAMBRIDGE
CB4 0WE

If the applicant is a corporate body, give the country/state of its incorporation — 08118317601
ENGLAND

4. Title of the invention — P38 MAP KINASE INHIBITORS

5. Name of your agent *(if you have one)* — MEWBURN ELLIS

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

YORK HOUSE
23 KINGSWAY
LONDON
WC2B 6HP

Patents ADP number *(if you know it)* — 109006

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month /year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request?
(Answer "Yes" if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	61
Claim(s)	0
Abstract	0
Drawing(s)	0

RM

10. If you are also filing any of the following, state how many against each item

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	9
Request for preliminary examination and search *(Patents Form 9/77)*	0
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(Please specify)*	0

11. I/We request the grant of a patent on the basis of this application.

Signature Date
3 July 2002

12. Name and daytime telephone number of person to contact in the United Kingdom — ROBERT J WATSON — 020 7240 4405

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed it it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

p38 MAP Kinase Inhibitors

This invention relates to pyridine derivatives which inhibit the activity of p38 MAP kinase, and the use of these compounds as pharmaceuticals.

Background

Mitogen-activated protein (MAP) kinases are proline-directed kinases that mediate the effects of numerous extracellular stimuli on a wide array of biological processes, such as cell proliferation, differentiation and death. p38 MAP kinases are one of three groups of mammalian MAP kinases which have been studied in detail, the other two groups being the extracellular signal-regulated kinases (ERK) and the c-Jun NH_2-terminal kinases (JNK).

There are five known human isoforms of p38 MAP kinase, p38α, p38β, p38β2, p38γ and p38δ. The p38 kinases, which are also known as cytokine suppressive anti-inflammatory drug binding proteins (CSBP), stress activated protein kinases (SAPK) and RK, are responsible for phosphorylating and activating transcription factors as well as other kinases, and are themselves activated by physical and chemical stress (e.g. UV, osmotic stress), pro-inflammatory cytokines and bacterial lipopolysaccharide (LPS) (Herlaar, E & Brown, Z., *Molecular Medicine Today*, 5: 439-447 (1999)). The products of p38 phosphorylation have been shown to mediate the production of inflammatory cytokines, including TNF and IL-1, and cyclooxygenase-2 (COX-2). Each of these cytokines has been implicated in numerous disease states and conditions. IL-1 and TNF are also known to stimulate the production of other proinflammatory cytokines such as IL-6 and IL-8.

Interleukin-1 (IL-1) and Tumor Necrosis Factor (TNF) are biological substances produced by a variety of cells, such as monocytes or macrophages. IL-1 has been demonstrated to mediate a variety of biological activities thought to be important in immunoregulation and other physiological conditions such as

inflammation (e.g. Dinarello, *et al.*, *Rev. Infect. Disease*, 6: 51 (1984)). The myriad of known biological activities of IL-1 include the activation of T helper cells, induction of fever, stimulation of prostaglandin or collagenase production, neutrophil chemotaxis, induction of acute phase proteins and the suppression of plasma iron levels.

There are many disease states in which excessive or unregulated IL-1 production is implicated in exacerbating and/or causing the disease. These include rheumatoid arthritis, osteoarthritis, endotoxemia and/or toxic shock syndrome, other acute or chronic inflammatory disease states such as the inflammatory reaction induced by endotoxin or inflammatory bowel disease; tuberculosis, atherosclerosis, muscle degeneration, cachexia, psoriatic arthritis, Reiter's syndrome, gout, traumatic arthritis, rubella arthritis, and acute synovitis. Evidence also links IL-1 activity to diabetes and pancreatic *B* cells (Dinarello, *J. Clinical Immunology*, 5: 287-297 (1985)).

Excessive or unregulated TNF production has been implicated in mediating or exacerbating a number of diseases including rheumatoid arthritis, rheumatoid spondylitis, osteoarthritis, gouty arthritis and other arthritic conditions; sepsis, septic shock, endotoxic shock, gram negative sepsis, toxic shock syndrome, adult respiratory distress syndrome, cerebral malaria, chronic pulmonary inflammatory disease, silicosis, pulmonary sarcoisosis, bone resorption diseases, reperfusion injury , graft vs. host reaction, allograft rejections, fever and myalgias due to infection, such as influenza, cachexia secondary to infection or malignancy, cachexia, secondary to acquired immune deficiency syndrome (AIDS), AIDS, ARC (AIDS related complex), keloid formation, scar tissue formation, Crohn's disease, ulcerative colitis, or pyresis.

Interleukin-8 (IL-8) is a chemotactic factor produced by several cell types including mononuclear cells, fibroblasts, endothelial cells, and keratinocytes. Its production from endothelial cells is induced by IL-1 [illegible]

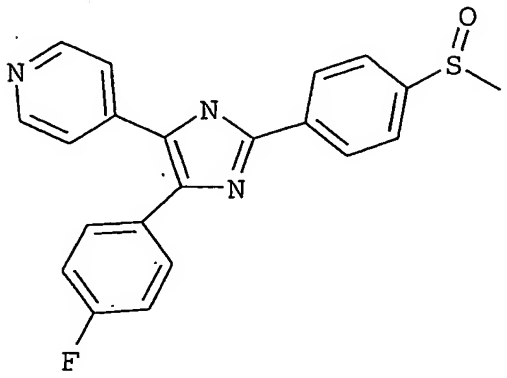
stimulates a number of functions in vitro. It has been shown to have chemoattractant properties for neutrophils, T -lymphocytes, and basophils. In addition it induces histamine release from basophils from both normal and atopic individuals as well as lysozomal enzyme release and respiratory burst from neutrophils. IL-8 has also been shown to increase the surface expression of Mac-1 (CD 11 *bICD* 18) on neutrophils without de novo protein synthesis, this may contribute to increased adhesion of the neutrophils to vascular endothelial cells. Many diseases are characterized by massive neutrophil infiltration. Conditions associated with an increased in IL-8 production (which is responsible for chemotaxis of neutrophil into the inflammatory site) would benefit by compounds which are suppressive of IL-8 production. Recently Chronic Obstructive Pulmonary Disease (COPD) has been linked to raised levels of IL-8 (Barnes *et al.*, *Curr. Opin. Pharmacol.*, 1: 242-7 (2001)). Other conditions linked to IL-8 include acute respiratory distress syndrome (ARDS), asthma, pulmonary fibrosis and bacterial pneumonia.

IL-1 and TNF affect a wide variety of cells and tissues and these cytokines as well as other leukocyte derived cytokines are important and critical inflammatory mediators of a wide variety of disease states and conditions. The inhibition of these cytokines is of benefit in controlling, reducing and alleviating many of these disease states.

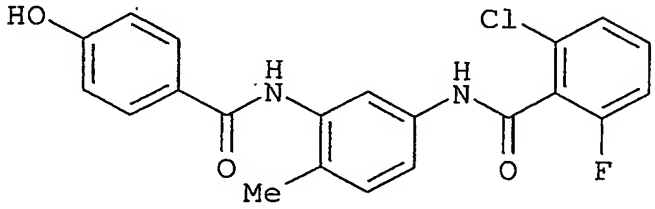
Inhibition of signal transduction via p38, which in addition to IL-1, TNF and IL-8 described above is also required for the synthesis and/or action of several additional pro-inflammatory proteins (i.e., IL-6, GM-CSF, COX-2, collagenase and stromelysin), is expected to be a highly effective mechanism for regulating the excessive and destructive activation of the immune system. This expectation is supported by the potent and diverse anti-inflammatory activities described for p38 kinase inhibitors (Badger, *et al., J. Pharm. Exp. Thera.*, 279: 1453-1461(1996); Griswold, *et at., Pharmacol. Comm.*, 7: 323-229 (1996)).

A number of inhibitors of p38 MAP kinase have been previously

disclosed. Smith-Kline Beecham's SB 203580 (see WO 93/14081) has the structure:

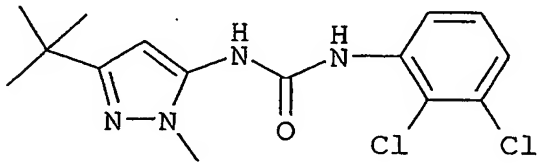


Zeneca have derived (WO 99/15164) compounds having structures related to:

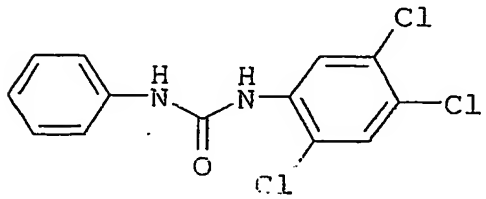


which exhibit inhibition of p38 activity.

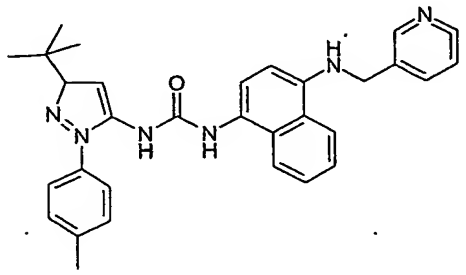
Bayer have disclosed a series of compounds which act as p38 MAP kinase inhibitors (WO 99/32111); one such compound has the structure:



Vertex have developed compounds as p38 MAP kinase inhibitors, with structures such as that shown below (WO 99/00357).



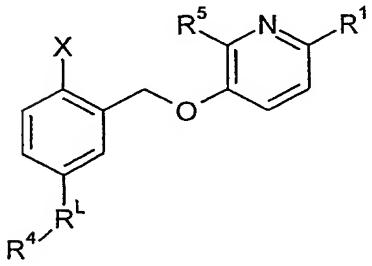
Boehringer Ingelheim have disclosed numerous compounds said to inhibit proinflammatory cytokines, such as TNF and IL-1, in, for example WO 00/43384. An example of a compound disclosed in that patent application is:



Summary of the Invention

The present inventors have discovered that pyridine derivatives that can be used as pharmaceuticals, and in particular can be used to inhibit the activity of p38 MAP kinase.

Accordingly, the first aspect of the present invention provides a compound of the formula I:



and isomers, salts, solvates and prodrugs thereof,

wherein:

R^1 is selected from H, NRR', NHC(=O)R, NHC(=O)NRR', NH_2SO_2R, and C(=O)NRR', where R and R' are independently selected from H and C_{1-4} alkyl, and are optionally substituted by OH, NH_2, C_{5-20} carboaryl, and C_{5-20} heteroaryl, or may together form, with the nitrogen atom to which they are attached, an optionally substituted nitrogen containing C_{5-7} heterocyclyl group;

R^5 is selected from H and NH_2;

X is selected from H and halo;

R^L is selected from -NH-C(=O)-, -NH-C(=O)-NH-, -NH-C(=O)-O- or -O-C(=O)-NH-;

R^4 is selected from H, optionally substituted C_{5-20} carboaryl and optionally substituted C_{5-20} heteroaryl, except that R^4 cannot be when R^4 is -NH-C(=O)-O-.

A second aspect of the present invention provides a composition comprising a compound of the first aspect and a pharmaceutically acceptable carrier or diluent.

A third aspect of the present invention provides a compound of the first aspect for use in a method of therapy.

A fourth aspect of the present invention provides the use of a compound of the first aspect for the manufacture of a medicament for use in the treatment of condition ameliorated by the inhibition of p38 MAP kinase.

Conditions ameliorated by the inhibition of p38 MAP kinase are discussed above, and include, but are not limited to, rheumatoid arthritis, osteoarthritis, rheumatoid spondylitis, gouty arthritis, traumatic arthritis, rubella arthritis, psoriatic arthritis, and other arthritic conditions; Alzheimer's disease; toxic shock syndrome, the inflammatory reaction induced by endotoxin or inflammatory bowel disease; tuberculosis, atherosclerosis, muscle degeneration, Reiter's syndrome, gout, acute synovitis, sepsis, septic shock, endotoxic shock, gram negative sepsis, adult respiratory distress syndrome, cerebral malaria, chronic pulmonary inflammatory disease, silicosis, pulmonary sarcoisosis, bone resorption diseases, reperfusion injury , graft vs. host reaction, allograft rejections, fever and myalgias due to infection, such as influenza, cachexia, in particular cachexia secondary to infection or malignancy, cachexia secondary to acquired immune deficiency syndrome (AIDS), AIDS, ARC (AIDS related complex), keloid formation, scar tissue formation, Crohn's disease, ulcerative colitis, pyresis, chronic obstructive pulmonary disease (COPD), acute respiratory distress

syndrome (ARDS), asthma, pulmonary fibrosis and bacterial pneumonia.

Thus, further aspects of the present invention provide the use of a compound of the first aspect of the invention for the manufacture of a medicament for use in the treatment of arthritic conditions or a proliferative disease.

Another aspect of the invention provides a method of inhibiting p38 MAP kinase *in vitro* or *in vivo*, comprising contacting a cell with an effective amount of a compound of the first aspect of the invention.

Another aspect of the invention pertains to a method for the treatment of a condition ameliorated by the inhibition of p38 MAP kinase comprising administering to a subject suffering from said condition ameliorated by the inhibition of p38 MAP kinase a therapeutically-effective amount of a compound of the first aspect of the invention.

Further aspects of the present invention pertain to methods of synthesising compounds of the first aspect of the invention, and intermediates in those synthesis routes.

Definitions

The phrase "optionally substituted," as used herein, pertains to a parent group which may be unsubstituted or which may be substituted.

Unless otherwise specified, the term "substituted," as used herein, pertains to a parent group which bears one or more substituents. The term "substituent" is used herein in the conventional sense and refers to a chemical moiety which is covalently attached to, appended to, or if appropriate, fused to, a parent group. A wide variety of substituents are well known, and methods for their formation and introduction into a variety of parent groups are also well known.

The substituents, and groups listed above, are described in more detail below.

C_{1-7} alkyl: The term "C_{1-7} alkyl", as used herein, pertains to a monovalent moiety obtained by removing a hydrogen atom from a carbon atom of a hydrocarbon compound having from 1 to 7 carbon atoms, which may be aliphatic or alicyclic, and which may be saturated, partially unsaturated, or fully unsaturated. Thus, the term "alkyl" includes the sub-classes alkenyl, alkynyl, cycloalkyl, etc., discussed below.

Examples of saturated alkyl groups include, but are not limited to, methyl (C_1), ethyl (C_2), propyl (C_3), butyl (C_4), pentyl (C_5), hexyl (C_6) and heptyl (C_7).

Examples of saturated linear alkyl groups include, but are not limited to, methyl (C_1), ethyl (C_2), n-propyl (C_3), n-butyl (C_4), n-pentyl (amyl) (C_5), n-hexyl (C_6), and n-heptyl (C_7).

Examples of saturated branched alkyl groups include iso-propyl (C_3), iso-butyl (C_4), sec-butyl (C_4), tert-butyl (C_4), iso-pentyl (C_5), and neo-pentyl (C_5).

C_{3-7} Cycloalkyl: The term "C_{3-7} cycloalkyl" as used herein, pertains to an alkyl group which is also a cyclyl group; that is, a monovalent moiety obtained by removing a hydrogen atom from an alicyclic ring atom of a cyclic hydrocarbon (carbocyclic) compound, which moiety has from 3 to 7 ring atoms. Preferably, each ring has from 3 to 7 ring atoms.

Examples of saturated cylcoalkyl groups include, but are not limited to, those derived from: cyclopropane (C_3), cyclobutane (C_4), cyclopentane (C_5), cyclohexane (C_6) and cycloheptane (C_7).

C_{2-7} Alkenyl: The term "C_{2-7} alkenyl" as used herein, pertains to an alkyl group having one or more carbon-carbon double bonds.

Examples of unsaturated alkenyl groups include, but are not limited to, ethenyl (vinyl, $-CH=CH_2$), 1-propenyl ($-CH=CH-CH_3$), 2-propenyl (allyl, $-CH-CH=CH_2$), isopropenyl ($-C(CH_3)=CH_2$), butenyl (C_4), pentenyl (C_5), and hexenyl (C_6).

Examples of unsaturated cyclic alkenyl groups, which are also referred to herein as "cycloalkenyl" groups, include, but are not limited to, cyclopropenyl (C_3), cyclobutenyl (C_4), cyclopentenyl (C_5), and cyclohexenyl (C_6).

C_{2-7} Alkynyl: The term "C_{2-7} alkynyl", as used herein, pertains to an alkyl group having one or more carbon-carbon triple bonds.

Examples of unsaturated alkynyl groups include, but are not limited to, ethynyl (ethinyl, $-C\equiv CH$) and 2-propynyl (propargyl, $-CH_2-C\equiv CH$).

C_{1-4} alkyl: The term "C_{1-4} alkyl", as used herein, pertains to a monovalent moiety obtained by removing a hydrogen atom from a carbon atom of a hydrocarbon compound having from 1 to 4 carbon atoms, which may be aliphatic or alicyclic, and which may be saturated, partially unsaturated, or fully unsaturated. Thus, the term "C_{1-4} alkyl" includes the sub-classes "C_{2-4} alkenyl", "C_{2-4} alkynyl" and "C_{2-4} cycloalkyl". Examples of these moieties are given above.

C_{3-20} Heterocyclyl: The term "C_{3-20} heterocyclyl" as used herein, pertains to a monovalent moiety obtained by removing a hydrogen atom from a ring atom of a heterocyclic compound, which moiety has from 3 to 20 ring atoms, of which from 1 to 10 are ring heteroatoms. Preferably, each ring has from 3 to 7 ring atoms, of which from 1 to 4 are ring heteroatoms, which include N, O and S.

Examples of monocyclic heterocyclyl groups include, but are not limited to, those derived from:

N_1: aziridine (C_3), azetidine (C_4), pyrrolidine (tetrahydropyrrole) (C_5), pyrroline (e.g., 3-pyrroline, 2,5-dihydropyrrole) (C_5), 2H-pyrrole or 3H-pyrrole (isopyrrole, isoazole) (C_5), piperidine (C_6), dihydropyridine (C_6), tetrahydropyridine (C_6), azepine (C_7);

O_1: oxirane (C_3), oxetane (C_4), oxolane (tetrahydrofuran) (C_5), oxole (dihydrofuran) (C_5), oxane (tetrahydropyran) (C_6), dihydropyran (C_6), pyran (C_6), oxepin (C_7);

S_1: thiirane (C_3), thietane (C_4), thiolane (tetrahydrothiophene) (C_5), thiane (tetrahydrothiopyran) (C_6), thiepane (C_7);

O_2: dioxolane (C_5), dioxane (C_6), and dioxepane (C_7);

O_3: trioxane (C_6);

N_2: imidazolidine (C_5), pyrazolidine (diazolidine) (C_5), imidazoline (C_5), pyrazoline (dihydropyrazole) (C_5), piperazine (C_6);

N_1O_1: tetrahydrooxazole (C_5), dihydrooxazole (C_5), tetrahydroisoxazole (C_5), dihydroisoxazole (C_5), morpholine (C_6), tetrahydrooxazine (C_6), dihydrooxazine (C_6), oxazine (C_6);

N_1S_1: thiazoline (C_5), thiazolidine (C_5), thiomorpholine (C_6);

N_2O_1: oxadiazine (C_6);

O_1S_1: oxathiole (C_5) and oxathiane (thioxane) (C_6); and,

$N_1O_1S_1$: oxathiazine (C_6).

Nitrogen containing C_{5-7} heterocyclyl: The term "nitrogen containing C_{5-7} heterocyclyl" as used herein, pertains to a monovalent moiety obtained by removing a hydrogen atom from a ring atom of a heterocyclic compound, which moiety has from 5 to 7 ring atoms, of which a least one is a nitrogen ring atom.

Examples of nitrogen containing C_{5-7} heterocyclyl groups include, but are not limited to, those derived from:

N_1: pyrrolidine (tetrahydropyrrole) (C_5), pyrroline (e.g., 3-pyrroline, 2,5-dihydropyrrole) (C_5), 2H-pyrrole or 3H-pyrrole (isopyrrole, isoazole) (C_5), piperidine (C_6), dihydropyridine (C_6), tetrahydropyridine (C_6), azepine (C_7);

N_2: imidazolidine (C_5), pyrazolidine (diazolidine) (C_5), imidazoline (C_5), pyrazoline (dihydropyrazole) (C_5), piperazine (C_6);

N_1O_1: tetrahydrooxazole (C_5), dihydrooxazole (C_5), tetrahydroisoxazole (C_5), dihydroisoxazole (C_5), morpholine (C_6), tetrahydrooxazine (C_6), dihydrooxazine (C_6), oxazine (C_6);

N_1S_1: thiazoline (C_5), thiazolidine (C_5), thiomorpholine (C_6);

N_2O_1: oxadiazine (C_6); and,

$N_1O_1S_1$: oxathiazine (C_6).

C_{5-20} carboaryl: The term "C_{5-20} carboaryl" as used herein, pertains to a monovalent moiety obtained by removing a hydrogen atom from an aromatic ring atom of an aromatic compound, which moiety has from 5 to 20 carbon ring atoms. Preferably, each ring has from 5 to 7 ring atoms.

Examples of carboaryl groups include, but are not limited to, those derived from benzene (i.e. phenyl) (C_6), naphthalene (C_{10}), azulene (C_{10}), anthracene (C_{14}), phenanthrene (C_{14}), naphthacene (C_{18}), and pyrene (C_{16}).

Examples of aryl groups which comprise fused rings, at least one of which is an aromatic ring, include, but are not limited to, groups derived from indene (C_9), isoindene (C_9), and fluorene (C_{13}).

C_{5-20} heteroaryl: The term "C_{5-20} heteroaryl" as used herein, pertains to a monovalent moiety obtained by removing a hydrogen atom from an aromatic ring atom of an aromatic compound, which moiety has from 5 to 20 ring atoms, which include one or more heteroatoms. Preferably, each ring has from 5 to 7 ring atoms.

Examples of monocyclic heteroaryl groups include, but are not limited to, those derived from:

N_1: pyrrole (azole) (C_5), pyridine (azine) (C_6);

O_1: furan (oxole) (C_5);

S_1: thiophene (thiole) (C_5);

N_1O_1: oxazole (C_5), isoxazole (C_5), isoxazine (C_6);

N_2O_1: oxadiazole (furazan) (C_5);

N_3O_1: oxatriazole (C_5);

N_1S_1: thiazole (C_5), isothiazole (C_5);

N_2: imidazole (1,3-diazole) (C_5), pyrazole (1,2-diazole) (C_5), pyridazine (1,2-diazine) (C_6), pyrimidine (1,3-diazine) (C_6) (e.g., cytosine, thymine, uracil), pyrazine (1,4-diazine) (C_6);

N_3: triazole (C_5), triazine (C_6); and,

N_4: tetrazole (C_5).

Examples of heteroaryl groups which comprise fused rings, include, but are not limited to:

C_9 heteroaryl groups (with 2 fused rings) derived from benzofuran (O_1), isobenzofuran (O_1), indole (N_1), isoindole (N_1), indolizine (N_1), indoline (N_1), isoindoline (N_1), purine (N_4) (e.g., adenine, guanine), benzimidazole (N_2), indazole (N_2), benzoxazole (N_1O_1), benzisoxazole (N_1O_1), benzodioxole (O_2), benzofurazan (N_2O_1), benzotriazole (N_3), benzothiofuran (S_1), benzothiazole (N_1S_1), benzothiadiazole (N_2S);

C_{10} heteroaryl groups (with 2 fused rings) derived from chromene (O_1), isochromene (O_1), chroman (O_1), isochroman (O_1), benzodioxan (O_2), quinoline (N_1), isoquinoline (N_1), quinolizine (N_1), benzoxazine (N_1O_1), benzodiazine (N_2), pyridopyridine (N_2), quinoxaline (N_2), quinazoline (N_2), cinnoline (N_2), phthalazine (N_2), naphthyridine (N_2), pteridine (N_4);

C_{13} heteroaryl groups (with 3 fused rings) derived from carbazole (N_1), dibenzofuran (O_1), dibenzothiophene (S_1), carboline (N_2), perimidine (N_2), pyridoindole (N_2); and,

C_{14} heteroaryl groups (with 3 fused rings) derived from acridine (N_1), xanthene (O_1), thioxanthene (S_1), oxanthrene (O_2), phenoxathiin (O_1S_1), phenazine (N_2), phenoxazine (N_1O_1), phenothiazine (N_1S_1), thianthrene (S_2), phenanthridine (N_1), phenanthroline (N_2), phenazine (N_2).

Heterocyclic groups (including heteroaryl groups) which have a nitrogen ring atom in the form of an -NH- group may be N-substituted, that is, as -NR-. For example, pyrrole may be N-methyl substituted, to give N-methypyrrole. Examples of N-substitutents include, but are not limited to C_{1-7} alkyl, C_{3-20} heterocyclyl, C_{5-20} carboaryl, C_{5-20} heteroaryl and acyl groups.

Heterocyclic groups (including heteroaryl groups) which have a nitrogen ring atom in the form of an -N= group may be substituted in the form of an N-oxide, that is, as $-N(\rightarrow O)=$ (also denoted $-N^+(\rightarrow O^-)=$). For example, quinoline may be substituted to give quinoline N-oxide; pyridine to give pyridine N-oxide; benzofurazan to give benzofurazan N-oxide (also known as benzofuroxan).

Cyclic groups may additionally bear one or more oxo (=O) groups on ring carbon atoms. Monocyclic examples of such groups include, but are not limited to, those derived from:

C_5: cyclopentanone, cyclopentenone, cyclopentadienone;

C_6: cyclohexanone, cyclohexenone, cyclohexadienone;

O_1: furanone (C_5), pyrone (C_6);

N_1: pyrrolidone (pyrrolidinone) (C_5), piperidinone (piperidone) (C_6), piperidinedione (C_6);

N_2: imidazolidone (imidazolidinone) (C_5), pyrazolone (pyrazolinone) (C_5), piperazinone (C_6), piperazinedione (C_6), pyridazinone (C_6), pyrimidinone (C_6) (e.g., cytosine), pyrimidinedione (C_6) (e.g., thymine, uracil), barbituric acid (C_6);

N_1S_1: thiazolone (C_5), isothiazolone (C_5);

N_1O_1: oxazolinone (C_5).

Polycyclic examples of such groups include, but are not limited to, those derived from:

C_9: indenedione;

C_{10}: tetralone, decalone;

C_{14}: anthrone, phenanthrone;

N_1: oxindole (C_9);

O_1: benzopyrone (e.g., coumarin, isocoumarin, chromone) (C_{10});

N_1O_1: benzoxazolinone (C_9), benzoxazolinone (C_{10});

N_2: quinazolinedione (C_{10});

N_4: purinone (C_9) (e.g., guanine).

Still more examples of cyclic groups which bear one or more oxo (=O) groups on ring carbon atoms include, but are not limited to, those derived from:

imides (-C(=O)-NR-C(=O)- in a ring), including but not limited to, succinimide (C_5), maleimide (C_5), phthalimide, and glutarimide (C_6);

lactones (cyclic esters, -O-C(=O)- in a ring), including, but not limited to, β-propiolactone, γ-butyrolactone, δ-valerolactone (2-piperidone), and ε-caprolactone;

lactams (cyclic amides, -NR-C(=O)- in a ring), including, but not limited to, β-propiolactam (C_4), γ-butyrolactam (2-pyrrolidone) (C_5), δ-valerolactam (C_6), and ε-caprolactam (C_7);

cyclic carbamates (-O-C(=O)-NR- in a ring), such as 2-oxazolidone (C_5);

cyclic ureas (-NR-C(=O)-NR- in a ring), such as 2-imidazolidone (C_5) and pyrimidine-2,4-dione (e.g., thymine, uracil) (C_6).

The above alkyl, heterocyclyl, carboaryl and heteroaryl groups, whether alone or part of another substituent, may themselves optionally be substituted with one or more groups selected from themselves and the additional substituents listed below, unless otherwise stated. Carboaryl and heteroaryl groups may also be substituted by alkoxylene groups as defined below.

Halo: -F, -Cl, -Br, and -I.

Hydroxy: -OH.

Ether: -OR, wherein R is an ether substituent, for example, a C_{1-7} alkyl group (also referred to as a C_{1-7} alkoxy group, discussed below), a C_{3-20} heterocyclyl group (also referred to as a C_{3-20} heterocyclyloxy group), or a C_{5-20} aryl group (also referred to as a C_{5-20} aryloxy group), preferably a C_{1-7} alkyl group. The term C_{5-20} aryl group encompasses both C_{5-20} carboaryl and C_{5-20} heteroaryl groups.

C_{1-7} alkoxy: -OR, wherein R is a C_{1-7} alkyl group. Examples of C_{1-7} alkoxy groups include, but are not limited to, -OMe (methoxy), -OEt (ethoxy), -O(nPr) (n-propoxy), -O(iPr) (isopropoxy), -O(nBu) (n-butoxy), -O(sBu) (sec-butoxy), -O(iBu) (isobutoxy), and -O(tBu) (tert-butoxy).

Acetal: $-CH(OR^1)(OR^2)$, wherein R^1 and R^2 are independently acetal substituents, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7}alkyl group, or, in the case of a "cyclic" acetal group, R^1 and R^2, taken together with the two oxygen atoms to which they are attached, and the carbon atoms to which they are attached, form a heterocyclic ring having from 4 to 8 ring atoms. Examples of acetal groups include, but are not limited to, $-CH(OMe)_2$, $-CH(OEt)_2$, and -CH(OMe)(OEt).

Hemiacetal: $-CH(OH)(OR^1)$, wherein R^1 is a hemiacetal substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of hemiacetal groups include, but are not limited to, -CH(OH)(OMe) and -CH(OH)(OEt).

Ketal: $-CR(OR^1)(OR^2)$, where R^1 and R^2 are as defined for acetals, and R is a ketal substituent other than hydrogen, for example, a C_{1-7} alkyl group; a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7}alkyl group. Examples ketal groups include, but

are not limited to, $-C(Me)(OMe)_2$, $-C(Me)(OEt)_2$, $-C(Me)(OMe)(OEt)$, $-C(Et)(OMe)_2$, $-C(Et)(OEt)_2$, and $-C(Et)(OMe)(OEt)$.

Hemiketal: $-CR(OH)(OR^1)$, where R^1 is as defined for hemiacetals, and R is a hemiketal substituent other than hydrogen, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of hemiketal groups include, but are not limited to, $-C(Me)(OH)(OMe)$, $-C(Et)(OH)(OMe)$, $-C(Me)(OH)(OEt)$, and $-C(Et)(OH)(OEt)$.

Oxo (keto, -one): =O.

Thione (thioketone): =S.

Imino (imine): =NR, wherein R is an imino substituent, for example, hydrogen, C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably hydrogen or a C_{1-7} alkyl group. Examples of ester groups include, but are not limited to, =NH, =NMe, =NEt, and =NPh.

Formyl (carbaldehyde, carboxaldehyde): $-C(=O)H$.

Acyl (keto): $-C(=O)R$, wherein R is an acyl substituent, for example, a C_{1-7} alkyl group (also referred to as C_{1-7} alkylacyl or C_{1-7} alkanoyl), a C_{3-20}heterocyclyl group (also referred to as C_{3-20} heterocyclylacyl), or a C_{5-20} aryl group (also referred to as C_{5-20} arylacyl), preferably a C_{1-7} alkyl group. Examples of acyl groups include, but are not limited to, $-C(=O)CH_3$ (acetyl), $-C(=O)CH_2CH_3$ (propionyl), $-C(=O)C(CH_3)_3$ (t-butyryl), and $-C(=O)Ph$ (benzoyl, phenone).

Carboxy (carboxylic acid): $-C(=O)OH$.

Thiocarboxy (thiocarboxylic acid): $-C(=S)SH$.

Thiolocarboxy (thiolocarboxylic acid): $-C(=O)SH$.

Thionocarboxy (thionocarboxylic acid): $-C(=S)OH$.

Imidic acid: $-C(=NH)OH$.

Hydroxamic acid: $-C(=O)NHOH$.

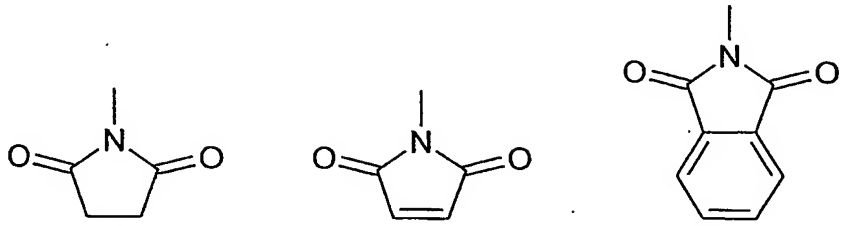
Ester (carboxylate, carboxylic acid ester, oxycarbonyl): $-C(=O)OR$, wherein R is an ester substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of ester groups include, but are not limited to, $-C(=O)OCH_3$, $-C(=O)OCH_2CH_3$, $-C(=O)OC(CH_3)_3$, and $-C(=O)OPh$.

Acyloxy (reverse ester): $-OC(=O)R$, wherein R is an acyloxy substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7}alkyl group. Examples of acyloxy groups include, but are not limited to, $-OC(=O)CH_3$ (acetoxy), $-OC(=O)CH_2CH_3$, $-OC(=O)C(CH_3)_3$, $-OC(=O)Ph$, and $-OC(=O)CH_2Ph$.

Amido (carbamoyl, carbamyl, aminocarbonyl, carboxamide): $-C(=O)NR^1R^2$, wherein R^1 and R^2 are independently amino substituents, as defined for amino groups. Examples of amido groups include, but are not limited to, $-C(=O)NH_2$, $-C(=O)NHCH_3$, $-C(=O)N(CH_3)_2$, $-C(=O)NHCH_2CH_3$, and $-C(=O)N(CH_2CH_3)_2$, as well as amido groups in which R^1 and R^2, together with the nitrogen atom to which they are attached, form a heterocyclic structure as in, for example, piperidinocarbonyl, morpholinocarbonyl, thiomorpholinocarbonyl, and piperazinocarbonyl.

Acylamido (acylamino): $-NR^1C(=O)R^2$, wherein R^1 is an amide substituent, for example, hydrogen, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably hydrogen or a C_{1-7} alkyl group, and R^2 is an acyl substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably hydrogen or a C_{1-7}alkyl group. Examples of acylamide groups include, but are not limited to, $-NHC(=O)CH_3$, $-NHC(=O)CH_2CH_3$, and $-NHC(=O)Ph$. R^1 and R^2 may together form a

cyclic structure, as in, for example, succinimidyl, maleimidyl, and phthalimidyl:



succinimidyl maleimidyl phthalimidyl

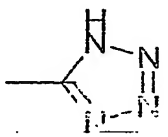
Thioamido (thiocarbamyl): $-C(=S)NR^1R^2$, wherein R^1 and R^2 are independently amino substituents, as defined for amino groups. Examples of amido groups include, but are not limited to, $-C(=S)NH_2$, $-C(=S)NHCH_3$, $-C(=S)N(CH_3)_2$, and $-C(=S)NHCH_2CH_3$.

Ureido: $-N(R^1)CONR^2R^3$ wherein R^2 and R^3 are independently amino substituents, as defined for amino groups, and R^1 is a ureido substituent, for example, hydrogen, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably hydrogen or a C_{1-7} alkyl group. Examples of ureido groups include, but are not limited to, $-NHCONH_2$, $-NHCONHMe$, $-NHCONHEt$, $-NHCONMe_2$, $-NHCONEt_2$, $-NMeCONH_2$, $-NMeCONHMe$, $-NMeCONHEt$, $-NMeCONMe_2$, and $-NMeCONEt_2$.

Carbamate: $-NR^1C(=O)OR^2$, wherein R^1 is an amide substituent, for example, hydrogen, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably hydrogen or a C_{1-7} alkyl group, and R^2 is an ester substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of carbamate groups include, but are not limited to, $-NHC(=O)OCH_3$, $-NHC(=O)OCH_2CH_3$, and $-NHC(=O)OPh$.

Guanidino: $-NH-C(=NH)NH_2$.

Tetrazolyl: a five membered aromatic ring having four nitrogen atoms and one carbon atom,



Amino: $-NR^1R^2$, wherein R^1 and R^2 are independently amino substituents, for example, hydrogen, a C_{1-7} alkyl group (also referred to as C_{1-7} alkylamino or di-C_{1-7} alkylamino), a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably H or a C_{1-7} alkyl group, or, in the case of a "cyclic" amino group, R^1 and R^2, taken together with the nitrogen atom to which they are attached, form a heterocyclic ring having from 4 to 8 ring atoms. Amino groups may be primary ($-NH_2$), secondary ($-NHR^1$), or tertiary ($-NHR^1R^2$), and in cationic form, may be quaternary ($-^+NR^1R^2R^3$). Examples of amino groups include, but are not limited to, $-NH_2$, $-NHCH_3$, $-NHC(CH_3)_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, and -NHPh. Examples of cyclic amino groups include, but are not limited to, aziridino, azetidino, pyrrolidino, piperidino, piperazino, morpholino, and thiomorpholino.

Imino: =NR, wherein R is an imino substituent, for example, for example, hydrogen, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably H or a C_{1-7} alkyl group. Examples of imino groups include, but are not limited to, =NH, =NMe, and =NEt.

Amidine (amidino): $-C(=NR)NR_2$, wherein each R is an amidine substituent, for example, hydrogen, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably H or a C_{1-7} alkyl group. Examples of amidine groups include, but are not limited to, $-C(=NH)NH_2$, $-C(=NH)NMe_2$, and $-C(=NMe)NMe_2$.

Nitro: $-NO_2$.

Azido: $-N_3$.

Cyano (nitrile, carbonitrile): -CN.

Cyanato: -OCN.

Sulfhydryl (thiol, mercapto): -SH.

Thioether (sulfide): -SR, wherein R is a thioether substituent, for example, a C_{1-7} alkyl group (also referred to as a C_{1-7} alkylthio group), a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7}alkyl group. Examples of C_{1-7} alkylthio groups include, but are not limited to, $-SCH_3$ and $-SCH_2CH_3$.

Sulfine (sulfinyl, sulfoxide): $-S(=O)R$, wherein R is a sulfine substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7}alkyl group. Examples of sulfine groups include, but are not limited to, $-S(=O)CH_3$ and $-S(=O)CH_2CH_3$.

Sulfone (sulfonyl): $-S(=O)_2R$, wherein R is a sulfone substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group, including, for example, a fluorinated or perfluorinated C_{1-7} alkyl group. Examples of sulfone groups include, but are not limited to, $-S(=O)_2CH_3$ (methanesulfonyl, mesyl), $-S(=O)_2CF_3$ (triflyl), $-S(=O)_2CH_2CH_3$ (esyl), $-S(=O)_2C_4F_9$ (nonaflyl), $-S(=O)_2CH_2CF_3$ (tresyl), $-S(=O)_2CH_2CH_2NH_2$ (tauryl), $-S(=O)_2Ph$ (phenylsulfonyl, besyl), 4-methylphenylsulfonyl (tosyl), 4-chlorophenylsulfonyl (closyl), 4-bromophenylsulfonyl (brosyl), 4-nitrophenyl (nosyl), 2-naphthalenesulfonate (napsyl), and 5-dimethylamino-naphthalen-1-ylsulfonate (dansyl).

Sulfinic acid (sulfino): $-S(=O)OH$, $-SO_2H$.

Sulfonic acid (sulfo): $-S(=O)_2OH$, $-SO_3H$.

Sulfinate (sulfinic acid ester): $-S(=O)OR$; wherein R is a sulfinate substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of sulfinate groups include, but are not limited to, $-S(=O)OCH_3$ (methoxysulfinyl; methyl sulfinate) and $-S(=O)OCH_2CH_3$ (ethoxysulfinyl; ethyl sulfinate).

Sulfonate (sulfonic acid ester): $-S(=O)_2OR$, wherein R is a sulfonate substituent, for example, a C_{1-7} alkyl group, a C_{3-20}

heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of sulfonate groups include, but are not limited to, $-S(=O)_2OCH_3$ (methoxysulfonyl; methyl sulfonate) and $-S(=O)_2OCH_2CH_3$ (ethoxysulfonyl; ethyl sulfonate).

Sulfinyloxy: $-OS(=O)R$, wherein R is a sulfinyloxy substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of sulfinyloxy groups include, but are not limited to, $-OS(=O)CH_3$ and $-OS(=O)CH_2CH_3$.

Sulfonyloxy: $-OS(=O)_2R$, wherein R is a sulfonyloxy substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of sulfonyloxy groups include, but are not limited to, $-OS(=O)_2CH_3$ (mesylate) and $-OS(=O)_2CH_2CH_3$ (esylate).

Sulfate: $-OS(=O)_2OR$; wherein R is a sulfate substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of sulfate groups include, but are not limited to, $-OS(=O)_2OCH_3$ and $-SO(=O)_2OCH_2CH_3$.

Sulfamyl (sulfamoyl; sulfinic acid amide; sulfinamide): $-S(=O)NR^1R^2$, wherein R^1 and R^2 are independently amino substituents, as defined for amino groups. Examples of sulfamyl groups include, but are not limited to, $-S(=O)NH_2$, $-S(=O)NH(CH_3)$, $-S(=O)N(CH_3)_2$, $-S(=O)NH(CH_2CH_3)$, $-S(=O)N(CH_2CH_3)_2$, and $-S(=O)NHPh$.

Sulfonamido (sulfinamoyl; sulfonic acid amide; sulfonamide): $-S(=O)_2NR^1R^2$, wherein R^1 and R^2 are independently amino substituents, as defined for amino groups. Examples of sulfonamido groups include, but are not limited to, $-S(=O)_2NH_2$, $-S(=O)_2NH(CH_3)$, $-S(=O)_2N(CH_3)_2$, $-S(=O)_2NH(CH_2CH_3)$, $-S(=O)_2N(CH_2CH_3)_2$, and $-S(=O)_2NHPh$.

Sulfamino: $-NR^1S(=O)_2OH$, wherein R^1 is an amino substituent, as defined for amino groups. Examples of sulfamino groups include, but are not limited to, $-NHS(=O)_2OH$ and $-N(CH_3)S(=O)_2OH$.

Sulfonamino: $-NR^1S(=O)_2R$, wherein R^1 is an amino substituent, as defined for amino groups, and R is a sulfonamino substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7} alkyl group. Examples of sulfonamino groups include, but are not limited to, $-NHS(=O)_2CH_3$ and $-N(CH_3)S(=O)_2C_6H_5$.

Sulfinamino: $-NR^1S(=O)R$, wherein R^1 is an amino substituent, as defined for amino groups, and R is a sulfinamino substituent, for example, a C_{1-7} alkyl group, a C_{3-20} heterocyclyl group, or a C_{5-20} aryl group, preferably a C_{1-7}alkyl group. Examples of sulfinamino groups include, but are not limited to, $-NHS(=O)CH_3$ and $-N(CH_3)S(=O)C_6H_5$.

Further groups

Alkoxylene: The term "alkoxylene" as used herein, pertains to a bidentate group which may be a substituent of an aryl group. It bonds to adjacent atoms of the aryl group, and may one or two carbon atoms in the chain between the oxygen atoms, as thus has the structure $-O(CH_2)_nO-$, where n is either 1 or 2. The carbon atoms may bear any of the substituents listed above.

Includes Other Forms

Unless otherwise specified, included in the above are the well known ionic, salt, solvate, and protected forms of these substituents. For example, a reference to carboxylic acid (-COOH) also includes the anionic (carboxylate) form ($-COO^-$), a salt or solvate thereof, as well as conventional protected forms. Similarly, a reference to an amino group includes the protonated form ($-N^+HR^1R^2$), a salt or solvate of the amino group, for example, a hydrochloride salt, as well as conventional protected forms of an amino group. Similarly, a reference to a hydroxyl group also includes the anionic form ($-O^-$), a salt or solvate

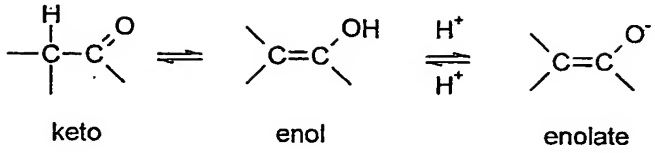
thereof, as well as conventional protected forms of a hydroxyl group.

Isomers, Salts, Solvates, Protected Forms, and Prodrugs

Certain compounds may exist in one or more particular geometric, optical, enantiomeric, diasteriomeric, epimeric, stereoisomeric, tautomeric, conformational, or anomeric forms, including but not limited to, cis- and trans-forms; E- and Z-forms; c-, t-, and r-forms; endo- and exo-forms; R-, S-, and meso-forms; D- and L-forms; d- and l-forms; (+) and (-) forms; keto-, enol-, and enolate-forms; syn- and anti-forms; synclinal- and anticlinal-forms; α- and β-forms; axial and equatorial forms; boat-, chair-, twist-, envelope-, and halfchair-forms; and combinations thereof, hereinafter collectively referred to as "isomers" (or "isomeric forms").

Note that, except as discussed below for tautomeric forms, specifically excluded from the term "isomers," as used herein, are structural (or constitutional) isomers (i.e., isomers which differ in the connections between atoms rather than merely by the position of atoms in space). For example, a reference to a methoxy group, $-OCH_3$, is not to be construed as a reference to its structural isomer, a hydroxymethyl group, $-CH_2OH$. Similarly, a reference to ortho-chlorophenyl is not to be construed as a reference to its structural isomer, meta-chlorophenyl. However, a reference to a class of structures may well include structurally isomeric forms falling within that class (e.g., C_{1-7}alkyl includes n-propyl and iso-propyl; butyl includes n-, iso-, sec-, and tert-butyl; methoxyphenyl includes ortho-, meta-, and para-methoxyphenyl).

The above exclusion does not pertain to tautomeric forms, for example, keto-, enol-, and enolate-forms, as in, for example, the following tautomeric pairs: keto/enol (illustrated below), imine/enamine, amide/imino alcohol, amidine/amidine, nitroso/oxime, thioketone/enethiol, and nitro/aci-nitro.



Note that specifically included in the term "isomer" are compounds with one or more isotopic substitutions. For example, H may be in any isotopic form, including ^{1}H, ^{2}H (D), and ^{3}H (T); C may be in any isotopic form, including ^{12}C, ^{13}C, and ^{14}C; O may be in any isotopic form, including ^{16}O and ^{18}O; and the like.

Unless otherwise specified, a reference to a particular compound includes all such isomeric forms, including (wholly or partially) racemic and other mixtures thereof. Isomeric forms substantially free, i.e. associated with less than 5%, preferably less than 2%, in particular less than 1%, of the other isomeric form are also envisaged. Methods for the preparation (e.g., asymmetric synthesis) and separation (e.g., fractional crystallisation and chromatographic means) of such isomeric forms are either known in the art or are readily obtained by adapting the methods taught herein, or known methods, in a known manner.

Unless otherwise specified, a reference to a particular compound also includes ionic, salt, solvate, and protected forms of thereof, for example, as discussed below.

It may be convenient or desirable to prepare, purify, and/or handle a corresponding salt of the active compound, for example, a pharmaceutically-acceptable salt. Examples of pharmaceutically acceptable salts are discussed in Berge *et al.*, 1977, "Pharmaceutically Acceptable Salts," J. Pharm. Sci., Vol. 66, pp. 1-19.

For example, if the compound is anionic, or has a functional group which may be anionic (e.g., -COOH may be $-COO^-$), then a salt may be formed with a suitable cation. Examples of suitable inorganic cations include, but are not limited to, alkali metal ions such as Na^+ and K^+, alkaline earth cations such as Ca^{2+} and

Mg^{2+}, and other cations such as Al^{3+}. Examples of suitable organic cations include, but are not limited to, ammonium ion (i.e., NH_4^+) and substituted ammonium ions (e.g., NH_3R^+, $NH_2R_2^+$, NHR_3^+, NR_4^+). Examples of some suitable substituted ammonium ions are those derived from: ethylamine, diethylamine, dicyclohexylamine, triethylamine, butylamine, ethylenediamine, ethanolamine, diethanolamine, piperazine, benzylamine, phenylbenzylamine, choline, meglumine, and tromethamine, as well as amino acids, such as lysine and arginine. An example of a common quaternary ammonium ion is $N(CH_3)_4^+$.

If the compound is cationic, or has a functional group which may be cationic (e.g., $-NH_2$ may be $-NH_3^+$), then a salt may be formed with a suitable anion. Examples of suitable inorganic anions include, but are not limited to, those derived from the following inorganic acids: hydrochloric, hydrobromic, hydroiodic, sulfuric, sulfurous, nitric, nitrous, phosphoric, and phosphorous.

Examples of suitable organic anions include, but are not limited to, those derived from the following organic acids: 2-acetyoxybenzoic, acetic, ascorbic, aspartic, benzoic, camphorsulfonic, cinnamic, citric, edetic, ethanedisulfonic, ethanesulfonic, fumaric, glucheptonic, gluconic, glutamic, glycolic, hydroxymaleic, hydroxynaphthalene carboxylic, isethionic, lactic, lactobionic, lauric, maleic, malic, methanesulfonic, mucic, oleic, oxalic, palmitic, pamoic, pantothenic, phenylacetic, phenylsulfonic, propionic, pyruvic, salicylic, stearic, succinic, sulfanilic, tartaric, toluenesulfonic, and valeric. Examples of suitable polymeric organic anions include, but are not limited to, those derived from the following polymeric acids: tannic acid, carboxymethyl cellulose.

It may be convenient or desirable to prepare, purify, and/or handle a corresponding solvate of the active compound. The term "solvate" is used herein in the conventional sense to refer to a complex of solute (e.g., active compound, salt of active compound) and solvent. If the solvent is water, the solvate may

be conveniently referred to as a hydrate, for example, a mono-hydrate, a di-hydrate, a tri-hydrate, etc.

It may be convenient or desirable to prepare, purify, and/or handle the active compound in a chemically protected form. The term "chemically protected form" is used herein in the conventional chemical sense and pertains to a compound in which one or more reactive functional groups are protected from undesirable chemical reactions under specified conditions (e.g., pH, temperature, radiation, solvent, and the like). In practice, well known chemical methods are employed to reversibly render unreactive a functional group, which otherwise would be reactive, under specified conditions. In a chemically protected form, one or more reactive functional groups are in the form of a protected or protecting group (also known as a masked or masking group or a blocked or blocking group). By protecting a reactive functional group, reactions involving other unprotected reactive functional groups can be performed, without affecting the protected group; the protecting group may be removed, usually in a subsequent step, without substantially affecting the remainder of the molecule. See, for example, Protective Groups in Organic Synthesis (T. Green and P. Wuts; 3rd Edition; John Wiley and Sons, 1999).

A wide variety of such "protecting," "blocking," or "masking" methods are widely used and well known in organic synthesis. For example, a compound which has two nonequivalent reactive functional groups, both of which would be reactive under specified conditions, may be derivatized to render one of the functional groups "protected," and therefore unreactive, under the specified conditions; so protected, the compound may be used as a reactant which has effectively only one reactive functional group. After the desired reaction (involving the other functional group) is complete, the protected group may be "deprotected" to return it to its original functionality.

For example, a hydroxy group may be protected as an ether (-OR) or an ester (-OC(=O)R), for example, as: a t-butyl ether; a

benzyl, benzhydryl (diphenylmethyl), or trityl (triphenylmethyl) ether; a trimethylsilyl or t-butyldimethylsilyl ether; or an acetyl ester (-OC(=O)CH_3, -OAc).

For example, an aldehyde or ketone group may be protected as an acetal (R-CH$(OR)_2$) or ketal ($R_2C(OR)_2$), respectively, in which the carbonyl group (>C=O) is converted to a diether (>C$(OR)_2$), by reaction with, for example, a primary alcohol. The aldehyde or ketone group is readily regenerated by hydrolysis using a large excess of water in the presence of acid.

For example, an amine group may be protected, for example, as an amide (-NRCO-R) or a urethane (-NRCO-OR), for example, as: a methyl amide (-NHCO-CH_3); a benzyloxy amide (-NHCO-$OCH_2C_6H_5$, -NH-Cbz); as a t-butoxy amide (-NHCO-$OC(CH_3)_3$, -NH-Boc); a 2-biphenyl-2-propoxy amide (-NHCO-$OC(CH_3)_2C_6H_4C_6H_5$, -NH-Bpoc), as a 9-fluorenylmethoxy amide (-NH-Fmoc), as a 6-nitroveratryloxy amide (-NH-Nvoc), as a 2-trimethylsilylethyloxy amide (-NH-Teoc), as a 2,2,2-trichloroethyloxy amide (-NH-Troc), as an allyloxy amide (-NH-Alloc), as a 2(-phenylsulphonyl)ethyloxy amide (-NH-Psec); or, in suitable cases (e.g., cyclic amines), as a nitroxide radical (>N-O•).

For example, a carboxylic acid group may be protected as an ester for example, as: an C_{1-7} alkyl ester (e.g., a methyl ester; a t-butyl ester); a C_{1-7} haloalkyl ester (e.g., a C_{1-7} trihaloalkyl ester); a triC_{1-7} alkylsilyl-C_{1-7}alkyl ester; or a C_{5-20} aryl-C_{1-7} alkyl ester (e.g., a benzyl ester; a nitrobenzyl ester); or as an amide, for example, as a methyl amide.

For example, a thiol group may be protected as a thioether (-SR), for example, as: a benzyl thioether; an acetamidomethyl ether (-S-CH_2NHC(=O)CH_3).

It may be convenient or desirable to prepare, purify, and/or handle the active compound in the form of a prodrug. The term "prodrug," as used herein, pertains to a compound which, when metabolised (e.g., in vivo), yields the desired active compound.

Typically, the prodrug is inactive, or less active than the active compound, but may provide advantageous handling, administration, or metabolic properties.

For example, some prodrugs are esters of the active compound (e.g., a physiologically acceptable metabolically labile ester). During metabolism, the ester group (-C(=O)OR) is cleaved to yield the active drug. Such esters may be formed by esterification, for example, of any of the carboxylic acid groups (-C(=O)OH) in the parent compound, with, where appropriate, prior protection of any other reactive groups present in the parent compound, followed by deprotection if required.

Examples of such metabolically labile esters include those of the formula -C(=O)OR wherein R is:
C_{1-7}alkyl
(e.g., -Me, -Et, -nPr, -iPr, -nBu, -sBu, -iBu, -tBu);
C_{1-7}aminoalkyl
(e.g., aminoethyl; 2-(N,N-diethylamino)ethyl;
2-(4-morpholino)ethyl); and
acyloxy-C_{1-7}alkyl
(e.g., acyloxymethyl;
acyloxyethyl;
pivaloyloxymethyl;
acetoxymethyl;
1-acetoxyethyl;
1-(1-methoxy-1-methyl)ethyl-carbonxyloxyethyl;
1-(benzoyloxy)ethyl; isopropoxy-carbonyloxymethyl;
1-isopropoxy-carbonyloxyethyl; cyclohexyl-carbonyloxymethyl;
1-cyclohexyl-carbonyloxyethyl;
cyclohexyloxy-carbonyloxymethyl;
1-cyclohexyloxy-carbonyloxyethyl;
(4-tetrahydropyranyloxy) carbonyloxymethyl;
1-(4-tetrahydropyranyloxy)carbonyloxyethyl;
(4-tetrahydropyranyl)carbonyloxymethyl; and
1-(4-tetrahydropyranyl)carbonyloxyethyl).

Also, some prodrugs are activated enzymatically to yield the active compound, or a compound which, upon further chemical reaction, yields the active compound (for example, as in ADEPT, GDEPT, LIDEPT, etc.). For example, the prodrug may be a sugar derivative or other glycoside conjugate, or may be an amino acid ester derivative.

Preferences

The following preferences apply to each aspect of the present invention, and preferred compounds may be different for different aspects. The following preferences for each group may be combined in any way with preferences for other groups.

R^1

R^1 is preferably selected from H and NRR', and more preferably from H and NHR. If R^1 is NHR, then R is preferably C_{1-4} alkyl (more preferably C_{1-2} alkyl) which may be, and is more preferably, substituted by OH, NH_2, C_{5-20} carboaryl (more preferably C_{5-10} carboaryl, e.g. phenyl), and C_{5-20} heteroaryl (more preferably C_{5-10} heteroaryl, e.g. pyridyl). Examples of preferred R^1 groups include, but are not limited to, $-NH-C_2H_4-OH$ and $-NH-CH_2-C_6H_5$.

R^5

R^5 is preferably H.

X

X is preferably halo, and more preferably F or Cl, with Cl being most preferred.

R^L

R^L is preferably selected from -NH-C(=O)-, -NH-C(=O)-NH- and -NH-C(=O)-O-, more preferably from -NH-C(=O)- and -NH-C(=O)-NH- and is most preferably -NH-C(=O)-.

R^4

R^4 is preferably a C_{5-20} carboaryl or C_{5-20} heteroaryl group, more preferably a C_{5-20} carboaryl group when R^L is -NH-C(=O)- and more preferably a C_{5-20} heteroaryl group when R^L is -NH-C(=O)-NH-.

Particularly preferred are monocyclic carboaryl and heteroaryl groups. If R^4 is a carboaryl group, it is preferably phenyl. If R^4 is a heteroaryl group it is preferably comprises at least one nitrogen ring atom (e.g. pyrrole, pyridine, thiazole, pyrazole, triazole), and is more preferably pyridine, thiazole or pyrazole, with pyrazole being the most preferred. Heteroaryl groups may be formed into a moeity by removing a hydrogen from a carbon or hetero ring atom, with the preference being for removal from a carbon ring atom.

The C_{5-20} carboaryl or C_{5-20} heteroaryl group is preferably substituted by one or more substituent groups, more preferably one or two substituents.

When R^4 is a six membered ring, it is preferred that at least one substituent group is in the meta position (i.e. β to attachment to R^L), and if there are two substituents these are both preferably in the meta positions.

When R^4 is a five membered ring, it is preferred that at least one substituent group is either α or γ to attachment to R^L, with the γ position being preferred.

The substituents are preferably selected from halo (more preferably F and Cl), amino (more preferably cyclic amino groups, and in particular morpholino), C_{1-7} alkyl (more preferably C_{1-4} alkyl, and in particular -Me, -*t*-Bu and $-CF_3$), C_{5-20} carboaryl groups (more preferably C_{5-10} carboaryl groups, and in particular, phenyl) and C_{5-20} heteroaryl groups (more preferably C_{5-10} heteroaryl groups).

Compounds of the present invention include N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-2-morpholin-4-yl-isonicotinamide (1), N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-fluoro-5-morpholin-4-yl-benzamide (2), N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-fluoro-benzamide (3), N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide (4) N-[4-Chloro-3-

(pyridin-3-yloxymethyl)-phenyl]-isonicotinamide (5), N-[3-(2-Amino-pyridin-3-yloxymethyl)-4-chloro-phenyl]-benzamide (6), N-[4-Fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide (7), 3-Fluoro-N-[4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide (8), 1-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-phenyl-urea (9), 3-Fluoro-N-[4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-5-morpholin-4-yl-benzamide (10), [4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea (11), 1-(5-tert-Butyl-2-phenyl-2H-pyrazol-3-yl)-3-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea (12), 3-tert-Butyl-N-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide (13), N-[3-(Pyridin-3-yloxymethyl)-phenyl]-benzamide (14), 3-Fluoro-5-morpholin-4-yl-N-[3-(pyridin-3-yloxymethyl)-phenyl]-benzamide (15), N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-trifluoromethyl-benzamide (16), 3-Chloro-N-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide (17), 1-(5-tert-Butyl-2H-pyrazol-3-yl)-3-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea (18), 6-Morpholin-4-yl-pyrazine-2-carboxylic acid [4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-amide (19), N-{4-Chloro-3-[6-(2-hydroxy-ethylamino)-pyridin-3-yloxymethyl]-phenyl}-3-fluoro-5-morpholin-4-yl-benzamide (20), N-[3-(6-Benzylamino-pyridin-3-yloxymethyl)-4-chloro-phenyl]-3-fluoro-5-morpholin-4-yl-benzamide (21), 1-(2-tert-Butyl-phenyl)-3-[4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-urea (22), [4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-carbamic acid phenyl ester (23) and 1-[4-Fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-3-(5-isopropyl-[1,3,4]thiadiazol-2-yl)-urea (24).

Of these compounds, the following are preferred embodiments of the invention: N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-2-morpholin-4-yl-isonicotinamide (1), N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-fluoro-5-morpholin-4-yl-benzamide (2), 3-Fluoro-N-[4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-5-morpholin-4-yl-benzamide (10), 1-(5-tert-Butyl-2-phenyl-2H-pyrazol-3-yl)-3-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea (12), 3-tert-Butyl-N-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide (13), N-{4-Chloro-3-[6-(2-hydroxy-ethylamino)-pyridin-3-yloxymethyl]-phenyl}-3-fluoro-5-morpholin-4-yl-benzamide (20), and N-[3-(6-Benzylamino-pyridin-3-yloxymethyl)-4-chloro-phenyl]-

3-fluoro-5-morpholin-4-yl-benzamide (21).

Acronyms

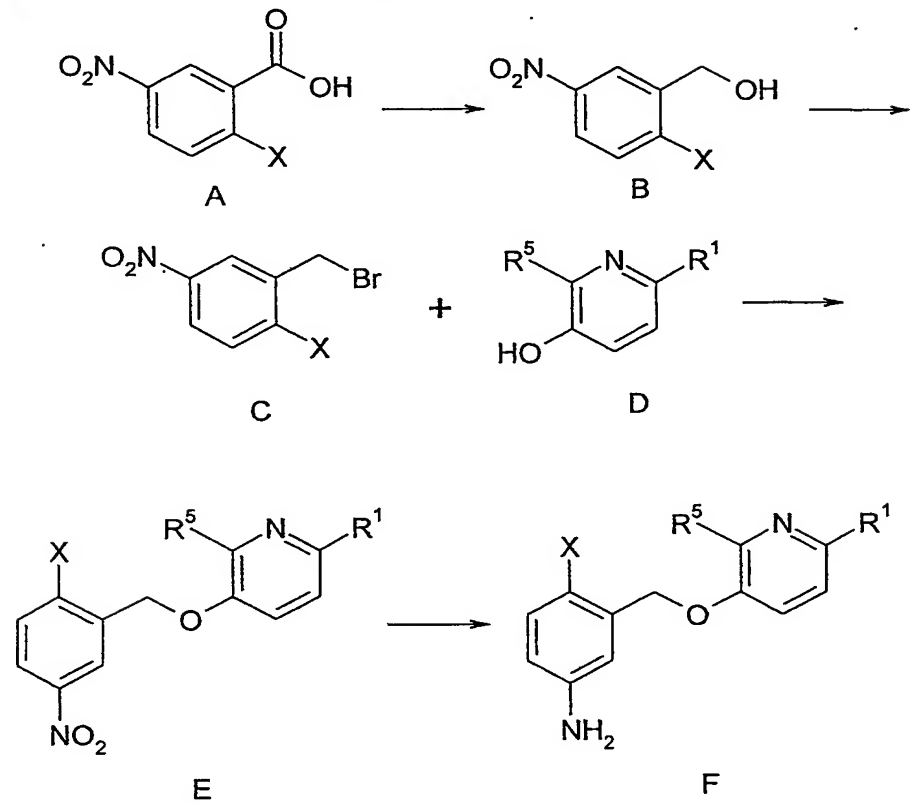
For convenience, many chemical moieties are represented using well known abbreviations, including but not limited to, methyl (Me), ethyl (Et), n-propyl (nPr), iso-propyl (iPr), n-butyl (nBu), sec-butyl (sBu), iso-butyl (iBu), tert-butyl (tBu), n-hexyl (nHex), cyclohexyl (cHex), phenyl (Ph), biphenyl (biPh), benzyl (Bn), naphthyl (naph), methoxy (MeO), ethoxy (EtO), benzoyl (Bz), and acetyl (Ac).

For convenience, many chemical compounds are represented using well known abbreviations, including but not limited to, methanol (MeOH), ethanol (EtOH), iso-propanol (i-PrOH), methyl ethyl ketone (MEK), ether or diethyl ether (Et_2O), acetic acid (AcOH), dichloromethane (methylene chloride, DCM), acetonitrile (ACN), trifluoroacetic acid (TFA), dimethylformamide (DMF), tetrahydrofuran (THF), and dimethylsulfoxide (DMSO).

Synthesis Routes

Several methods for the chemical synthesis of compounds of the present invention are described herein. These methods may be modified and/or adapted in known ways in order to facilitate the synthesis of additional compounds within the scope of the present invention. The amounts of reactants given are for guidance. Descriptions of general laboratory methods and procedures, useful for the preparation of the compounds of the present invention, are described in Vogel's Textbook of Practical Organic Chemistry (5^{th} edition, Ed. Furniss, B. S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R., Longmann, UK). Methods for the synthesis of pyridine containing molecules in particular are described in Heterocyclic Chemistry, Joule, J.A., Mills, R., and Smith, G.F., Chapman & Hall, London.

Synthesis of first key intermediate



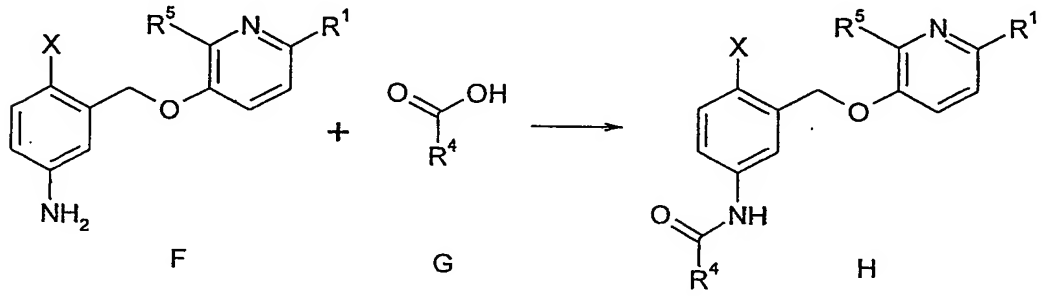
Scheme 1

A key intermediate in the synthesis of compounds of the present invention is the appropriately substituted 3-(pyridin-3-yloxymethyl)-phenylamine (F), as shown in Scheme 1. Scheme 1 illustrates one method of synthesis of this intermediate, although other routes to it are also possible.

The 3-(pyridin-3-yloxymethyl)-phenylamine (F) is synthesised from the corresponding 3-(5-nitro-benzyloxy)pyridine (E) by reduction of the 5-nitro group, using, for example, a metal reducing agent. This 3-(5-nitro-benzyloxy)pyridine (E) is itself synthesised by the base mediated addition of 1-bromomethyl-3-nitro-phenyl (C), or 6-halo equivalent, to the appropriately substituted 3-hydroxy pyridine (D).

The 1-bromomethyl-3-nitro-phenyl (C), or 6-halo equivalent, can be synthesised from the corresponding 3-nitro-benzoic acid (A), via the (3-nitro-phenyl) methanol (B). The first step is a reduction, using, for example, sodium borohydride, and the second step is a halo-de-hydroxylation, achieved, for example, by the use of triphenyl phosphine and carbon tetrabromide.

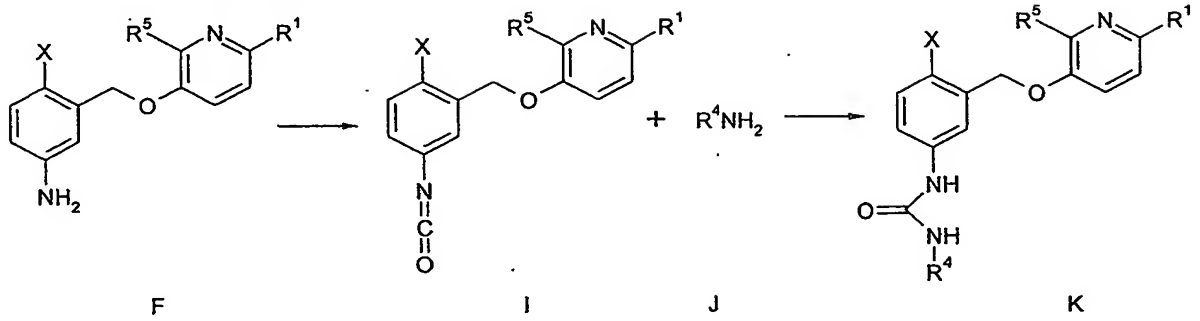
R^L = -NH-C(=O)-



Scheme 2

When R^L is -NH-C(=O)-, the desired final compound (H) is made by the reaction between the appropriate 3-(pyridin-3-yloxymethyl)-phenylamine (F) and the aromatic acid (G), or formic acid (where R^4 is H). Due to the relative unreactivity of the phenyl amine, this reaction is usually carried out with the aid of an activiator or promoter. Activation of the acid can be achieved by converting it into the corresponding acid chloride, for example, by using oxalyl chloride. An alternative method employs amide bond forming promoters, 1[3-(dimethylamino)propyl]-3-ethylcarbodiimide hydrochloride (EDCI) and 7-aza-1-hydroxybenzotriazole (HOAt) or 1-hydroxy benzotriazole (HOBt).

R^L = -NH-C(=O)-NH-

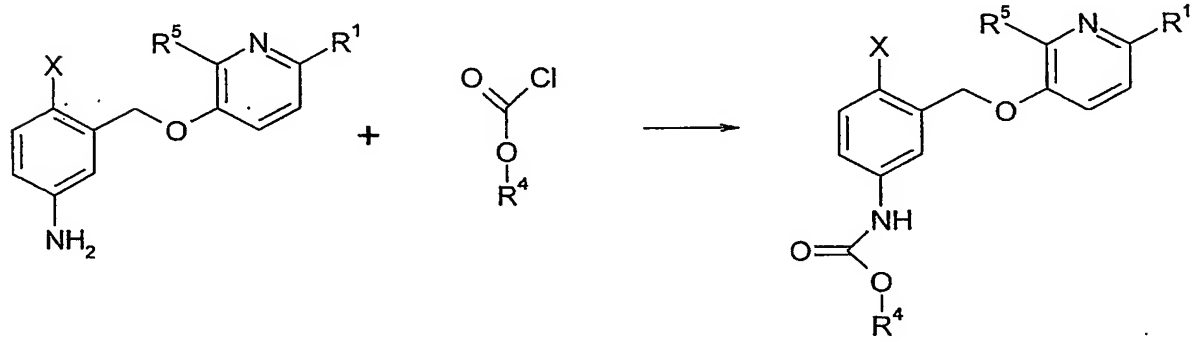


F I J K

Scheme 3

When R^L is -NH-C(=O)-NH-, then the desired final product (K) can be synthesised by the conversion of the appropriate 3-(pyridin-3-yloxymethyl)-phenylamine (F) to the corresponding 3-(pyridin-3-yloxymethyl)-phenyl isocyanate (I), followed by addition of the appropriate aromatic amine (J), or ammonium hydroxide (where R^4=H) without the need for isolation of the isocyanate (I).

R^L = -NH-C(=O)-O-



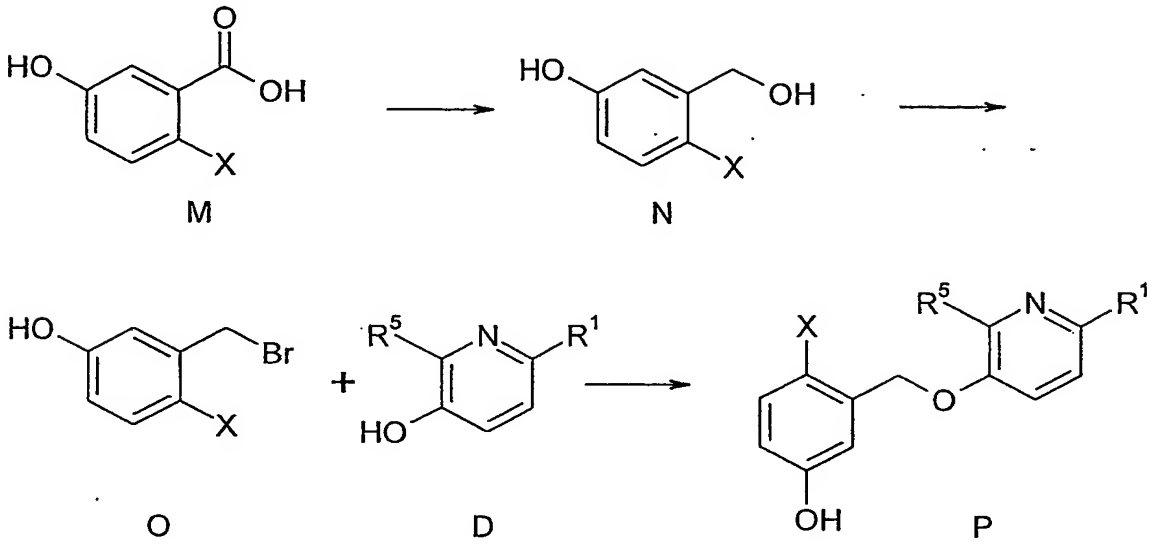
F K L

Scheme 4

When R^L is -NH-C(=O)-O-, then the desired final product (L) can be synthesised by the addition of the appropriate aromatic chloroformate (K) to the appropriate 3-(pyridin-3-yloxymethyl)-phenylamine (F).

R^L = -O-C(=O)-NH-

These compounds are synthesised from a different intermediate to the above.

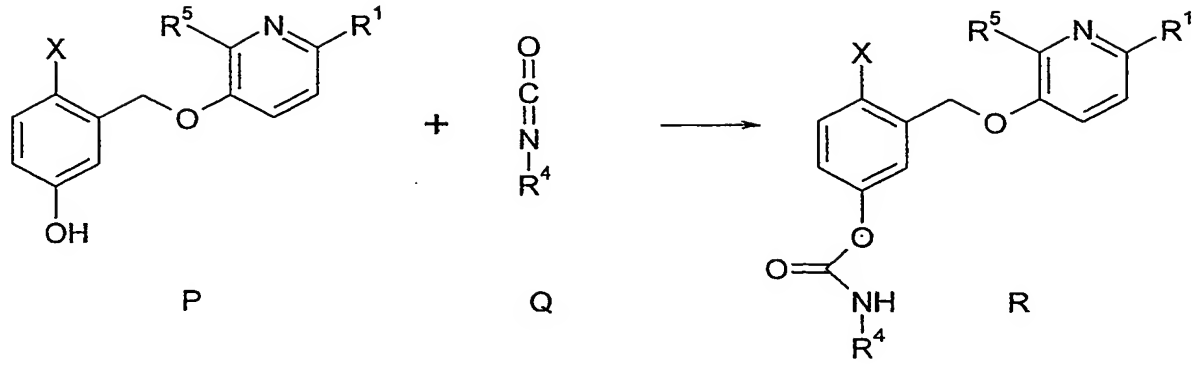


Scheme 5

The intermediate is an appropriately substituted 3-(pyridin-3-yloxymentyl)phenol (P), as shown in Scheme 5. Scheme 5 illustrates one method of synthesis of this intermediate, although other routes to it are possible.

The 3-(pyridin-3-yloxymentyl)phenol (P) is synthesised by the base mediated addition of 1-bromomethyl-3-hydroxy-phenyl (O), or 6-halo equivalent, to the appropriately substituted 3-hydroxy pyridine (D).

The 1-bromomethyl-3-hydroxy-phenyl (O), or 6-halo equivalent, can be synthesised from the corresponding 3-hydroy-benzoic acid (M), via the (3-hydroxy)-phenyl) methanol (N). The first step is a reduction, using, for example sodium borohydride, and the second step is a halo-de-hydroxylation, achieved, for example, by the use of triphenyl phosphine and carbon tetrabromide.



P Q R

Scheme 6

The desired final compound (R) is made by the base mediated reaction between the appropriate 3-(pyridin-3-yloxymentyl)phenol and the aromatic isocynate (Q), or TMS isocyanate (where R^4 is H). An appropriate base would be triethylamine.

R^1 and R^5

R^1 and R^5 are usually incorporated into the starting materials of the above routes by known methods starting from available compounds, and may need protection, depending on the reagents used in each step of the synthesis. However, where appropriate, they may be introduced at other stages in the above described routes.

When R^1 is -NRR', one possible method of introducing this substituent is to synthesise the key intermediate with R^1=F, and then carry out direct substitution with HNRR'.

When R^1 is -C(=O)NRR', the desired product can be synthesised with R^1=-C(=O)OH, followed by addition of HNRR', using conventional means to aid amide bond formation (see above).

When R^1 is -NHC(=O)NRR', the desired product can be synthesised with R^1=-C(=O)OH, which can then be converted to $-C(=O)-N_3^-$, using, for example thionyl chloride followed by sodium azide, followed by heating to undergo a Curtius rearrangement to the corresponding isocyanate, which then can undergo addition of HNRR' to form the desired final product.

The isocyanate can also be trapped using tert-butanol to yield a tert-butyl protected carbamic acid, which then undergo base mediated substitution of an appropriate halo-compound (Hal-R), to provide an alternative route to compounds where R^1 is NHR.

When R^1 is $-NHSO_2R$, the desired product can be synthesised using the methods described in *J. Med. Chem.*, **1991**, 34(4), 1356-1362, JP 57-038777 and *J. Het. Chem.*, **1980**, 17(1), 11-16.

When R^1 is $-NH-C(=O)-R$, the desired product can be derived from compounds where $R^1=NH_2$, by reaction with $R-C(=O)OH$, or an activated version thereof, for example $R-C(=O)Cl$.

Use of Compounds of the Invention

The present invention provides active compounds, specifically, active pyridine derivatives as defined in the first aspect.

The term "active," as used herein, pertains to compounds which are capable of inhibiting p38 MAP kinase activity, and specifically includes both compounds with intrinsic activity (drugs) as well as prodrugs of such compounds, which prodrugs may themselves exhibit little or no intrinsic activity.

One of ordinary skill in the art is readily able to determine whether or not a candidate inhibits p38 kinase activity. For example, an assay which may conveniently be used in order to assess the inhibition of p38 MAP kinase activity offered by a particular compound is described in the examples below.

The present invention further provides a method of inhibiting p38 MAP kinase activity in a cell, comprising contacting said cell with an effective amount of an active compound, preferably in the form of a pharmaceutically acceptable composition. Such a method may be practised *in vitro* or *in vivo*.

The invention further provides active compounds for use in a method of treatment of the human or animal body. Such a method may comprise administering to such a subject a therapeutically-effective amount of an active compound, preferably in the form of a pharmaceutical composition.

The term "treatment" as used herein in the context of treating a condition, pertains generally to treatment and therapy, whether of a human or an animal (e.g. in veterinary applications), in which some desired therapeutic effect is achieved, for example, the inhibition of the progress of the condition, and includes a reduction in the rate of progress, a halt in the rate of progress, amelioration of the condition, and cure of the condition. Treatment as a prophylactic measure (i.e. prophylaxis) is also included.

The term "therapeutically-effective amount" as used herein, pertains to that amount of an active compound, or a material, composition or dosage from comprising an active compound, which is effective for producing some desired therapeutic effect, commensurate with a reasonable benefit/risk ratio, when administered in accordance with a desired treatment regimen.

The term "treatment" includes combination treatments and therapies, in which two or more treatments or therapies are combined, for example, sequentially or simultaneously. Examples of treatments and therapies include, but are not limited to, chemotherapy (the administration of active agents, including, e.g., drugs, antibodies (e.g., as in immunotherapy), prodrugs (e.g., as in photodynamic therapy, GDEPT, ADEPT, etc.); surgery; radiation therapy; and gene therapy.

The invention further provides the use of an active compound for the manufacture of a medicament, for example, for the treatment of a condition ameliorated by the inhibition of p38 MAP kinase.

The invention further provides a method of treatment of the human or animal body, the method comprising administering to a subject

in need of treatment a therapeutically-effective amount of an active compound, preferably in the form of a pharmaceutical composition.

Active compounds may also be used as part of an *in vitro* assay, for example, in order to determine whether a candidate host is likely to benefit from treatment with the compound in question.

Administration

The active compound or pharmaceutical composition comprising the active compound may be administered to a subject by any convenient route of administration, whether systemically/peripherally or at the site of desired action, including but not limited to, oral (e.g. by ingestion); topical (including e.g. transdermal, intranasal, ocular, buccal, and sublingual); pulmonary (e.g. by inhalation or insufflation therapy using, e.g. an aerosol, e.g. through mouth or nose); rectal; vaginal; parenteral, for example, by injection, including subcutaneous, intradermal, intramuscular, intravenous, intraarterial, intracardiac, intrathecal, intraspinal, intracapsular, subcapsular, intraorbital, intraperitoneal, intratracheal, subcuticular, intraarticular, subarachnoid, and intrasternal; by implant of a depot, for example, subcutaneously or intramuscularly.

The subject may be a eukaryote, an animal, a vertebrate animal, a mammal, a rodent (e.g. a guinea pig, a hamster, a rat, a mouse), murine (e.g. a mouse), canine (e.g. a dog), feline (e.g. a cat), equine (e.g. a horse), a primate, simian (e.g. a monkey or ape), a monkey (e.g. marmoset, baboon), an ape (e.g. gorilla, chimpanzee, orang-utan, gibbon), or a human.

Formulations

While it is possible for the active compound to be administered alone, it is preferable to present it as a pharmaceutical composition (e.g. formulation) comprising at least one active compound, as defined above, together with one or more pharmaceutically acceptable carriers, adjuvants, excipients,

diluents, fillers, buffers, stabilisers, preservatives, lubricants, or other materials well known to those skilled in the art and optionally other therapeutic or prophylactic agents.

Thus, the present invention further provides pharmaceutical compositions, as defined above, and methods of making a pharmaceutical composition comprising admixing at least one active compound, as defined above, together with one or more pharmaceutically acceptable carriers, excipients, buffers, adjuvants, stabilizers, or other materials, as described herein.

The term "pharmaceutically acceptable" as used herein pertains to compounds, materials, compositions, and/or dosage forms which are, within the scope of sound medical judgment, suitable for use in contact with the tissues of a subject (e.g. human) without excessive toxicity, irritation, allergic response, or other problem or complication, commensurate with a reasonable benefit/risk ratio. Each carrier, excipient, etc. must also be "acceptable" in the sense of being compatible with the other ingredients of the formulation.

Suitable carriers, excipients, etc. can be found in standard pharmaceutical texts, for example, Remington's Pharmaceutical Sciences, 18th edition, Mack Publishing Company, Easton, Pa., 1990.

The formulations may conveniently be presented in unit dosage form and may be prepared by any methods well known in the art of pharmacy. Such methods include the step of bringing into association the active compound with the carrier which constitutes one or more accessory ingredients. In general, the formulations are prepared by uniformly and intimately bringing into association the active compound with liquid carriers or finely divided solid carriers or both, and then if necessary shaping the product.

Formulations may be in the form of liquids, solutions, suspensions, emulsions, elixirs, syrups, tablets, losenges,

granules, powders, capsules, cachets, pills, ampoules, suppositories, pessaries, ointments, gels, pastes, creams, sprays, mists, foams, lotions, oils, boluses, electuaries, or aerosols.

Formulations suitable for oral administration (e.g. by ingestion) may be presented as discrete units such as capsules, cachets or tablets, each containing a predetermined amount of the active compound; as a powder or granules; as a solution or suspension in an aqueous or non-aqueous liquid; or as an oil-in-water liquid emulsion or a water-in-oil liquid emulsion; as a bolus; as an electuary; or as a paste.

A tablet may be made by conventional means, e.g., compression or moulding, optionally with one or more accessory ingredients. Compressed tablets may be prepared by compressing in a suitable machine the active compound in a free-flowing form such as a powder or granules, optionally mixed with one or more binders (e.g. povidone, gelatin, acacia, sorbitol, tragacanth, hydroxypropylmethyl cellulose); fillers or diluents (e.g. lactose, microcrystalline cellulose, calcium hydrogen phosphate); lubricants (e.g. magnesium stearate, talc, silica); disintegrants (e.g. sodium starch glycolate, cross-linked povidone, cross-linked sodium carboxymethyl cellulose); surface-active or dispersing or wetting agents (e.g. sodium lauryl sulfate); and preservatives (e.g. methyl p-hydroxybenzoate, propyl p-hydroxybenzoate, sorbic acid). Moulded tablets may be made by moulding in a suitable machine a mixture of the powdered compound moistened with an inert liquid diluent. The tablets may optionally be coated or scored and may be formulated so as to provide slow or controlled release of the active compound therein using, for example, hydroxypropylmethyl cellulose in varying proportions to provide the desired release profile. Tablets may optionally be provided with an enteric coating, to provide release in parts of the gut other than the stomach.

Formulations suitable for topical administration (e.g. transdermal, intranasal, ocular, buccal, and sublingual) may be

formulated as an ointment, cream, suspension, lotion, powder, solution, past, gel, spray, aerosol, or oil. Alternatively, a formulation may comprise a patch or a dressing such as a bandage or adhesive plaster impregnated with active compounds and optionally one or more excipients or diluents.

Formulations suitable for topical administration in the mouth include losenges comprising the active compound in a flavoured basis, usually sucrose and acacia or tragacanth; pastilles comprising the active compound in an inert basis such as gelatin and glycerin, or sucrose and acacia; and mouthwashes comprising the active compound in a suitable liquid carrier.

Formulations suitable for topical administration to the eye also include eye drops wherein the active compound is dissolved or suspended in a suitable carrier, especially an aqueous solvent for the active compound.

Formulations suitable for nasal administration, wherein the carrier is a solid, include a coarse powder having a particle size, for example, in the range of about 20 to about 500 microns which is administered in the manner in which snuff is taken, i.e. by rapid inhalation through the nasal passage from a container of the powder held close up to the nose. Suitable formulations wherein the carrier is a liquid for administration as, for example, nasal spray, nasal drops, or by aerosol administration by nebuliser, include aqueous or oily solutions of the active compound.

Formulations suitable for administration by inhalation include those presented as an aerosol spray from a pressurised pack, with the use of a suitable propellant, such as dichlorodifluoromethane, trichlorofluoromethane, dichoro-tetrafluoroethane, carbon dioxide, or other suitable gases.

Formulations suitable for topical administration via the skin include ointments, creams, and emulsions. When formulated in an ointment, the active compound may optionally be employed with

either a paraffinic or a water-miscible ointment base. Alternatively, the active compounds may be formulated in a cream with an oil-in-water cream base. If desired, the aqueous phase of the cream base may include, for example, at least about 30% w/w of a polyhydric alcohol, i.e., an alcohol having two or more hydroxyl groups such as propylene glycol, butane-1,3-diol, mannitol, sorbitol, glycerol and polyethylene glycol and mixtures thereof. The topical formulations may desirably include a compound which enhances absorption or penetration of the active compound through the skin or other affected areas. Examples of such dermal penetration enhancers include dimethylsulfoxide and related analogues.

When formulated as a topical emulsion, the oily phase may optionally comprise merely an emulsifier (otherwise known as an emulgent), or it may comprises a mixture of at least one emulsifier with a fat or an oil or with both a fat and an oil. Preferably, a hydrophilic emulsifier is included together with a lipophilic emulsifier which acts as a stabiliser. It is also preferred to include both an oil and a fat. Together, the emulsifier(s) with or without stabiliser(s) make up the so-called emulsifying wax, and the wax together with the oil and/or fat make up the so-called emulsifying ointment base which forms the oily dispersed phase of the cream formulations.

Suitable emulgents and emulsion stabilisers include Tween 60, Span 80, cetostearyl alcohol, myristyl alcohol, glyceryl monostearate and sodium lauryl sulphate. The choice of suitable oils or fats for the formulation is based on achieving the desired cosmetic properties, since the solubility of the active compound in most oils likely to be used in pharmaceutical emulsion formulations may be very low. Thus the cream should preferably be a non-greasy, non-staining and washable product with suitable consistency to avoid leakage from tubes or other containers. Straight or branched chain, mono- or dibasic alkyl esters such as di-isoadipate, isocetyl stearate, propylene glycol diester of coconut fatty acids, isopropyl myristate, decyl oleate, isopropyl palmitate, butyl stearate, 2-ethylhexyl

palmitate or a blend of branched chain esters known as Crodamol CAP may be used, the last three being preferred esters. These may be used alone or in combination depending on the properties required.

Alternatively, high melting point lipids such as white soft paraffin and/or liquid paraffin or other mineral oils can be used.

Formulations suitable for rectal administration may be presented as a suppository with a suitable base comprising, for example, cocoa butter or a salicylate.

Formulations suitable for vaginal administration may be presented as pessaries, tampons, creams, gels, pastes, foams or spray formulations containing in addition to the active compound, such carriers as are known in the art to be appropriate.

Formulations suitable for parenteral administration (e.g. by injection, including cutaneous, subcutaneous, intramuscular, intravenous and intradermal), include aqueous and non-aqueous isotonic, pyrogen-free, sterile injection solutions which may contain anti-oxidants, buffers, preservatives, stabilisers, bacteriostats, and solutes which render the formulation isotonic with the blood of the intended recipient; and aqueous and non-aqueous sterile suspensions which may include suspending agents and thickening agents, and liposomes or other microparticulate systems which are designed to target the compound to blood components or one or more organs. Examples of suitable isotonic vehicles for use in such formulations include Sodium Chloride Injection, Ringer's Solution, or Lactated Ringer's Injection. Typically, the concentration of the active compound in the solution is from about 1 ng/ml to about 10 µg/ml, for example from about 10 ng/ml to about 1 µg/ml. The formulations may be presented in unit-dose or multi-dose sealed containers, for example, ampoules and vials, and may be stored in a freeze-dried (lyophilised) condition requiring only the addition of the sterile liquid carrier, for example water for injections,

immediately prior to use. Extemporaneous injection solutions and suspensions may be prepared from sterile powders, granules, and tablets. Formulations may be in the form of liposomes or other microparticulate systems which are designed to target the active compound to blood components or one or more organs.

Dosage

It will be appreciated that appropriate dosages of the active compounds, and compositions comprising the active compounds, can vary from patient to patient. Determining the optimal dosage will generally involve the balancing of the level of therapeutic benefit against any risk or deleterious side effects of the treatments of the present invention. The selected dosage level will depend on a variety of factors including, but not limited to, the activity of the particular compound, the route of administration, the time of administration, the rate of excretion of the compound, the duration of the treatment, other drugs, compounds, and/or materials used in combination, and the age, sex, weight, condition, general health, and prior medical history of the patient. The amount of compound and route of administration will ultimately be at the discretion of the physician, although generally the dosage will be to achieve local concentrations at the site of action which achieve the desired effect without causing substantial harmful or deleterious side-effects.

Administration *in vivo* can be effected in one dose, continuously or intermittently (e.g. in divided doses at appropriate intervals) throughout the course of treatment. Methods of determining the most effective means and dosage of administration are well known to those of skill in the art and will vary with the formulation used for therapy, the purpose of the therapy, the target cell being treated, and the subject being treated. Single or multiple administrations can be carried out with the dose level and pattern being selected by the treating physician.

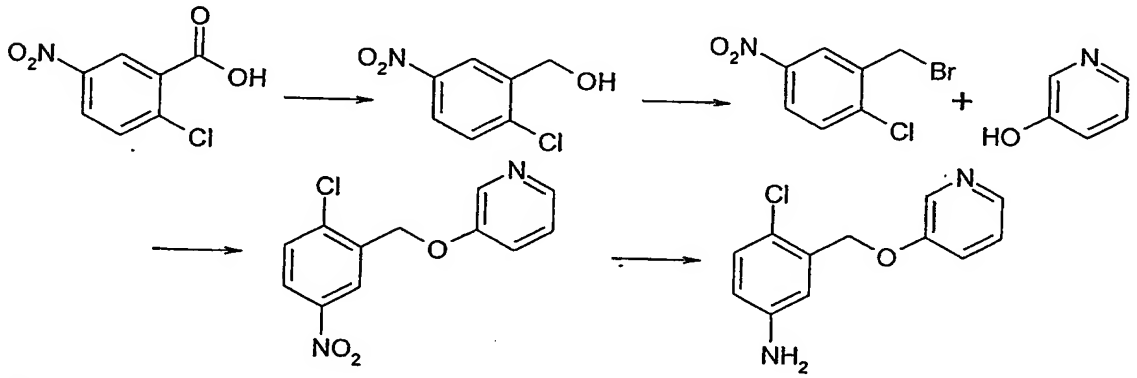
In general, a suitable dose of the active compound is in the range of about 100 ng to about 10 mg, more preferably 10 ng to 1

mg, per kilogram body weight of the subject per day. Where the active compound is a salt, an ester, prodrug, or the like, the amount administered is calculated on the basis of the parent compound and so the actual weight to be used is increased proportionately.

EXAMPLES

Example 1

(a) Synthesis of key intermediate: 4-chloro-3-(pyridin-3-yloxymethyl)-phenylamine



(2-chloro-5-nitro-phenyl)-methanol

To a stirred suspension of sodium borohydride (9.9 mmol) in dry THF (20 ml) at 0°C was added 2-chloro-5-nitrobenzoic acid (4.96 mmol) dissolved in dry THF (5 ml). Boron trifluoride etherate (13.3 mmol) was added dropwise and the reaction mixture allowed to warm to room temperature over 1 hour. The reaction mixture was quenched with 1N HCl and then partitioned between DCM and water. The organic layer was separated, washed with brine solution, dried ($MgSO_4$), filtered, evaporated and the residue purified by column chromatography on silica. Elution with mixtures of petroleum ether and ethyl acetate afforded 0.92g of the desired product; MS(ES): m/e 189 (M+H); δ_H (400 MHz, $CDCl_3$) 8.5 (1H, br s), 8.13 (1H, br dd), 7.54 (1H, d, J 8), 4.89 (2H, s).

2-bromomethyl-1-chloro-4-nitro-benzene

(2-Chloro-5-nitro-phenyl)-methanol (4.9 mmol) was dissolved in DCM (30 ml) and cooled to 0°C. Triphenyl phosphine (5 mmol) was

added followed by carbon tetrabromide (4.9 mmol). The reaction mixture was diluted with DCM and washed with water and brine solution. The organic layer was separated, dried ($MgSO_4$), filtered and evaporated to yield 1.23g of the desired product; MS (ES): m/e 252 (M+H); δ_H (400 MHz, $CDCl_3$) 8.37 (1H, br s), 8.15 (1H, dd, J 8, 1), 7.61 (1H, d, J 8), 4.63 (2H, s).

3-(2-chloro-5-nitro-benzyloxy)-pyridine

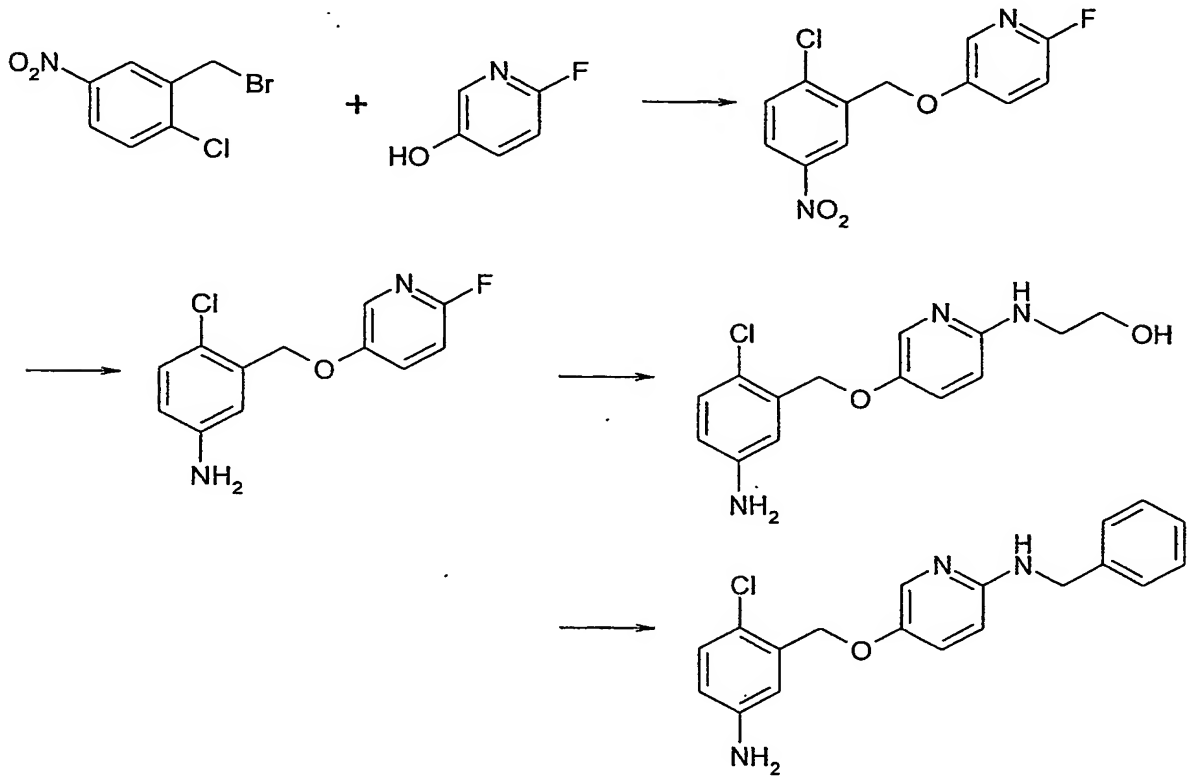
3-Hydroxy pyridine (5.3 mmol) was dissolved in dry DMF (6 ml), cooled to 0°C and then treated with sodium hydride (60%, 5.5 mmol). After 20 mins, 2-bromomethyl-1-chloro-4-nitro-benzene 4.9 mmol) was added in dry DMF (6 ml) and the reaction mixture stirred at 0°C for 1 hour. The reaction mixture was quenched with water, then partitioned between ethyl acetate and water. The organic layer was separated, washed with brine solution, dried ($MgSO_4$), filtered, evaporated and the residue purified by column chromatography on silica. Elution with mixtures of petroleum ether and ethyl acetate afforded 0.32g of the desired product; MS(ES): m/e 266 (M+H).

4-chloro-3-(pyridin-3-yloxymethyl)-phenylamine

3-(2-chloro-5-nitro-benzyloxy)-pyridine (1.2 mmol) was dissolved in dioxan:water (5:1, 6 ml), and treated with iron powder (10.9 mmol) and iron sulfate heptahydrate (2.66 mmol). The reaction mixture was refluxed for 6 hours, cooled to room temperature and filtered. The filtrate was diluted with ethyl acetate and washed with saturated bicarbonate and brine solution. The organic layer was separated, dried ($MgSO_4$), filtered and evaporated to give 195mg of the desired product; MS(ES): m/e 236 (M+H).

The corresponding key intermediates 3-(pyridin-3-yloxymethyl)-phenylamine, 4-fluoro-3-(pyridin-3-yloxymethyl)-phenylamine and 4-chloro-3-(6-hydroxymethylamino-pyridin-3-yloxymethyl)-phenylamine were synthesised in a similar fashion.

(b) **Synthesis of key intermediates 4-chloro-3-(6-benzylamino-pyridin-3-yloxymethyl)-phenylamine and 4-chloro-3-(2-amino-pyridin-3-yloxymethyl)-phenylamine**



5-(2-Chloro-5-nitro-benzyloxy)-2-fluoro-pyridine

To a solution of 2-fluoro-5-hydroxypyridine (1.77 mmol) in DMF (4 ml) was added NaH (60% dispersion in mineral oil, 4.42 mmol) in small portions at room temperature and under an atmosphere of nitrogen. After stirring for 1 hour, tetra-*n*-butylammonium chloride (17.68 µmol) was added, followed by 2-chloro-5-nitrobenzyl bromide (5.31 mmol)(see above). After stirring for a further 17 hours, MeOH (2 ml) and then water (2 ml) were added. The DMF was removed *in vacuo* and the residue was partitioned between ethyl acetate (50 ml) and water (25 ml). The organic layer was separated and the aqueous layer was extracted with ethyl acetate (2 x 40 ml). The combined organic extracts were then dried ($MgSO_4$), filtered and concentrated. Purification by flash chromatography eluting with EtOAc/40-60 petroleum ether (1:19) gave the desired compound as a pale yellow oil. δ_H (400 MHz; $CDCl_3$) 5.23 (2H, s), 6.94 (1H, dd, *J* 8.8 and 3.5), 7.46-7.51 (1H, m), 7.61 (1H, d, *J* 8.8), 7.95-7.98 (1H, m), 8.19 (1H,

dd, *J* 8.6 and 2.6), 8.49 (1H, d, *J* 2.6).

4-Chloro-3-(6-fluoro-pyridin-3-yloxymethyl)-phenylamine

To a solution of 5-(2-Chloro-5-nitro-benzyloxy)-2-fluoro-pyridine (5.31 mmol) in dioxane/water (5:1, 30 ml) was added iron powder (47.8 mmol) followed by iron sulphate heptahydrate (11.7 mmol) and the reaction mixture was heated to reflux for a period of 17 hours. Upon cooling, the reaction mixture was filtered through a plug of celite, washed with ethyl acetate (250 ml) and the solvent removed *in vacuo*. Purification of the residue by flash chromatography eluting with EtOAc/40-60 petroleum ether (3:7) gave the desired compound. δ_H (400 MHz; d_6-DMSO) 5.07 (2H, s), 5.33 (2H, br s), 6.55 (1H, dd, *J* 8.6 and 2.8), 6.74 (1H, d, *J* 2.8), 7.09 (1H, d, *J* 8.6), 7.14 (1H, dd, *J* 9.1 and 3.0), 7.62-7.68 (1H, m), 7.96 (1H, dd, *J* 3.0 and 1.8).

2-[5-(5-Amino-2-chloro-benzyloxy)-pyridin-2-ylamino]-ethanol

A stirred solution of 4-chloro-3-(6-fluoro-pyridin-3-yloxymethyl)-phenylamine (0.49 mmol) in ethanolamine (2.5 ml) was heated to 130 °C for 24 hours. Upon cooling, the reaction mixture was partitioned between ethyl acetate (80 ml) and water (40 ml). The organic layer was separated and the aqueous layer was extracted with ethyl acetate (2 x 40 ml). The combined organic extracts were then dried ($MgSO_4$), filtered and concentrated *in vacuo*. Purification by flash chromatography eluting with EtOAc/40-60 petroleum ether (1:1) gave the title compound as a pale yellow oil (85 mg, 56%). δ_H (400 MHz; $CDCl_3$) 3.40-3.44 (2H, m), 3.66 (2H, br s), 3.78 (2H, t, *J* 4.6), 4.66 (1H, br s), 4.99 (2H, s), 6.42 (1H, d, *J* 8.8), 6.55 (1H, dd, *J* 8.6 and 2.8), 6.82 (1H, d, *J* 2.8), 7.12 (1H, d, *J* 8.6), 7.15 (1H, dd, *J* 9.0 and 3.0), 7.80 (1H, d, *J* 2.8).

[5-(5-Amino-2-chloro-benzyloxy)-pyridin-2-yl]-benzylamine

This was prepared in an analogous manner to 2-[5-(5-Amino-2-chloro-benzyloxy)-pyridin-2-ylamino]-ethanol, but using benzylamine in place of ethanolamine. MS(ES): m/e 340 (M+H).

Example 2: Synthesis of compounds where R^L=-NH-C(=O)-

(a) First method

Synthesis of N-[4-Chloro-3-pyridin-3-yloxymethyl)-phenyl]-2-morpholin-4-yl-isonicotinamide - Compound 1

A stirred solution of 2-morpholin-4-yl-isonicotinic acid (0.24 mmol) in dry DCM (5ml) at 0°C was treated with oxalyl chloride (0.29 mmol) and DMF (one drop). The mixture was stirred at 0°C for 1 hour, then the solvent was removed under reduced pressure. The residue was dissolved in dry DCM (3ml) and treated dropwise with 4-chloro-3-(pyridin-2-yloxymethyl)-phenylamine (0.16mmol) and triethylamine (0.16ml) at 0°C. The reaction mixture was allowed to warm to room temperature overnight, then diluted with DCM and washed with 5% citric acid, saturated bicarbonate solution and brine solution. The organic layer was separated, dried ($MgSO_4$), filtered, evaporated and the residue purified by column chromatography on silica. Elution with mixtures of petroleum ether and ethyl acetate afforded the desired product. MS(ES): m/e 426 (M+H).

The following compounds were synthesised using a similar method, but with the appropriate starting materials:

from 4-chloro-3-(pyridin-3-yloxymethyl)-phenylamine

N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-fluoro-5-morpholin-4-yl-benzamide - Compound 2, MS(ES): m/e 443 (M+H); N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-fluoro-benzamide - Compound 3, MS(ES): m/e 358 (M+H); N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide - Compound 4, MS(ES): m/e 340 (M+H); N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-isonicotinamide - Compound 5, MS(ES): m/e 341 (M+H); N-[3-(2-Amino-pyridin-3-yloxymethyl)-4-chloro-phenyl]-benzamide - Compound 6, MS(ES): m/e 355 (M+H).

from 4-fluoro-3-(pyridin-3-yloxymethyl)-phenylamine

N-[4-Fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide - Compound 7, MS(ES): m/e 323 (M+H); 3-Fluoro-N-[4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide - Compound 8, MS(ES): m/e 341 (M+H); 3-Fluoro-N-[4-fluoro-3-(pyridin-3-yloxymethyl)-

phenyl]-5-morpholin-4-yl-benzamide - Compound 10, MS(ES): m/e 426 (M+H).

from 3-(pyridin-3-yloxymethyl)-phenylamine

N-[3-(Pyridin-3-yloxymethyl)-phenyl]-benzamide - Compound 14, MS(ES): m/e 305 (M+H).

(b) Second method

Synthesis of 3-Tert-butyl-N-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide - Compound 13

A stirred solution 4-chloro-3-(pyridin-2-yloxymethyl)-phenylamine (0.14 mmol) in dry DCM (5ml) was treated with EDCI (1.68 mmol) and HOAt (1.68 mmol). 3-Tert-butyl benzoic acid (0.14 mmol) was added and the reaction mixture stirred at room temperature overnight. The reaction mixture was diluted with DCM and washed with 5% citric acid, saturated bicarbonate solution and brine solution. The organic layer was separated, dried ($MgSO_4$), filtered, evaporated and the residue purified by column chromatography on silica. Elution with mixtures of petroleum ether and ethyl acetate afforded the desired product. MS(ES): m/e 396 (M+H)

The following compounds were synthesised using a similar method, but with the appropriate starting materials:

From 4-chloro-3-(6-hydroxymethylamino-pyridin-3-yloxymethyl)-phenylamine

N-{4-Chloro-3-[6-(2-hydroxy-ethylamino)-pyridin-3-yloxymethyl]-phenyl}-3-fluoro-5-morpholin-4-yl-benzamide - Compound 20, MS(ES): m/e 502 (M+H).

from 4-chloro-3-(6-benzylamino-pyridin-3-yloxymethyl)-phenylamine

N-[3-(6-Benzylamino-pyridin-3-yloxymethyl)-4-chloro-phenyl]-3-fluoro-5-morpholin-4-yl-benzamide - Compound 21, MS(ES): m/e 548 (M+H).

from 4-chloro 3-(pyridin-3-yloxymethyl)-phenylamine

N-[4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-3-trifluoromethyl-

benzamide - Compound 16, MS(ES): m/e 408 (M+H); 3-Chloro-N-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-benzamide - Compound 17, MS(ES): m/e 374 (M+H).

from 4-fluoro-3-(pyridin-3-yloxymethyl)-phenylamine

6-Morpholin-4-yl-pyrazine-2-carboxylic acid [4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-amide - Compound 19, MS(ES): m/e 410 (M+H); 1-(2-tert-Butyl-phenyl)-3-[4-fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-urea - Compound 22, MS(ES): m/e 394 (M+H).

from 3-(pyridin-3-yloxymethyl)-phenylamine

3-Fluoro-5-morpholin-4-yl-N-[3-(pyridin-3-yloxymethyl)-phenyl]-benzamide - Compound 15, MS(ES): m/e 408 (M+H).

Example 3: Synthesis of compounds where R^L=-NH-C(=O)-NH-

Synthesis of 1-(5-tert-Butyl-2H-pyrazol-3-yl)-3-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea - Compound 18

A stirred solution of 4-chloro-3-(pyridin-3-yloxymethyl)-phenylamine (0.21 mmol) in dry DCM (5 ml) at 0°C was treated with diisopropyl ethylamine (2.13 mmol), followed by triphosgene (0.25 mmol). The mixture was stirred at 0°C for 3 hours, then treated with 3-amino-5-tert-butyl pyrazole (0.42 mmol). The reaction mixture was allowed to warm to room temperature overnight, then solvent was removed under reduced pressure and the residue partitioned between ethyl acetate and saturated bicarbonate solution. The organic layer was separated, dried ($MgSO_4$), filtered, evaporated and the residue purified by column chromatography on silica. Elution with mixtures of petroleum ether and ethyl acetate afforded 20mg of the desired product; MS(ES): m/e 401 (M+H).

The following compounds were synthesised using a similar method, but with the appropriate starting materials:

from 4-chloro-3-(pyridin-3-yloxymethyl)-phenylamine

1-phenyl-3-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea - Compound 9, MS(ES): m/e 355 (M+H); 1-(5-tert-Butyl-2-phenyl-pyrazol-3-yl)-3-[4-chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea

- Compound 12, MS(ES): m/e 477 (M+H); [4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-urea, Compound 11, MS(ES): m/e 279 (M+H), using 2M aqueous ammonium chloride in place of aromatic amine.

from 4-fluoro-3-(pyridin-3-yloxymethyl)-phenylamine
1-[4-Fluoro-3-(pyridin-3-yloxymethyl)-phenyl]-3-(5-isopropyl-[1,3,4]thiadiazol-2-yl)-urea - Compound 24, MS(ES): m/e 388 (M+H).

Example 4: Synthesis of compounds where R^L=-NH-C(=O)-O-

Synthesis of [4-Chloro-3-(pyridin-3-yloxymethyl)-phenyl]-carbamic acid phenyl ester - Compound 23

A stirred solution of 4-chloro-3-(pyridin-3-yloxymethyl)-phenylamine (0.21 mmol) and pyridine in dry DCM (0.5 ml) at 0°C was treated with phenyl chloroformate (0.22 mmol). The reaction mixture was warmed to room temperature over 1 hour then diluted with DCM and washed with 5% citric acid, saturated bicarbonate solution and brine solution. The organic layer was separated, dried ($MgSO_4$), filtered, evaporated and the residue purified by column chromatography on silica. Elution with mixtures of petroleum ether and ethyl acetate afforded 70mg of the desired product; MS(ES): m/e 356 (M+H).

p38 MAP kinase assay

In 1 ml of fresh assay buffer (25 mM HEPES pH 7.4, 25 mM ß-glycerphosphate, 5 mM EDTA, 15 mM $MgCl_2$, 100 µM ATP, 1 mM sodium orthovanadate, 1 mM DTT), 35 µg of inactive purified p38 and 0.12 µg of active MKK6 (1688 U/mg - Upstate Biotechnology) are mixed and incubated at room temperature for four hours to activate the p38.

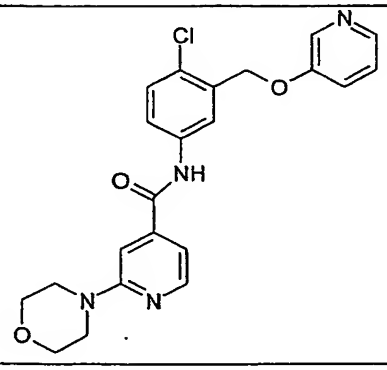
The activated p38 is then diluted with an equal volume of assay buffer, and 20 µl mixed with 25 µl of MBP mix (300 µl 10 x strength assay buffer, 300 µl of 10 mM DTT & 10 mM sodium orthovanadate, 1.7 ml H_20, 50 µCi $\gamma^{33}P$-ATP, 200 µl of myelin basic protein (MBP)(5 mg/ml)) and added to 96 well plates along with 5 µl of various dilutions of the test compound in DMSO (up to 10%

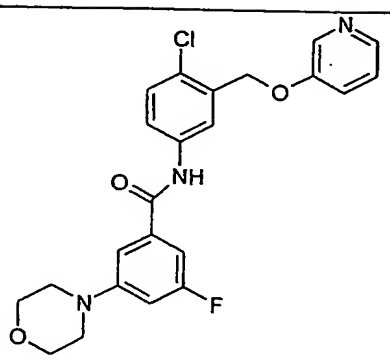
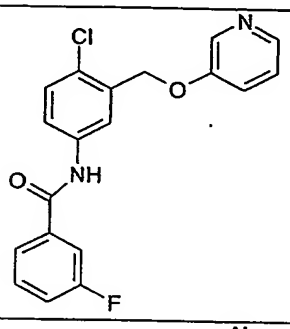
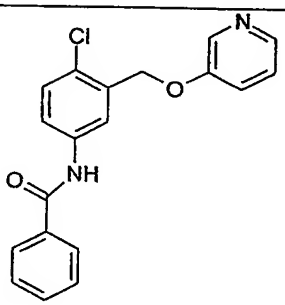
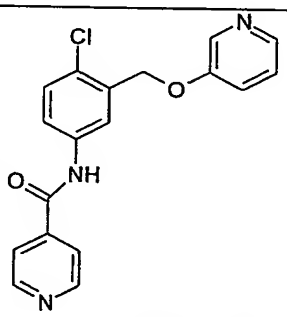
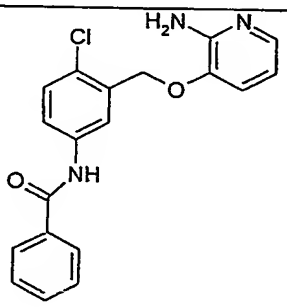
The reaction is allowed to proceed for one to one and a half hours before being stopped with an excess of ortho-phosphoric acid (30 µl at 2%).

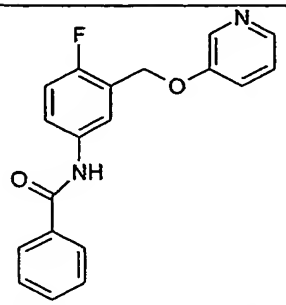
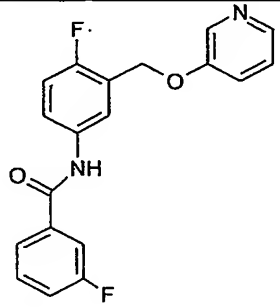
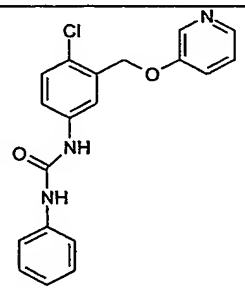
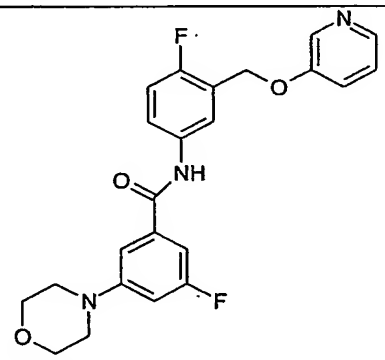
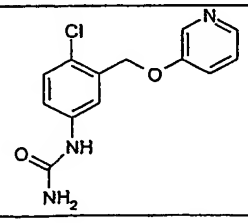
γ^{33}P-ATP which remains unincorporated into the myelin basic protein is separated from phosphorylated MBP on a Millipore MAPH filter plate. The wells of the MAPH plate are wetted with 0.5% orthophosphoric acid, and then the results of the reaction are filtered with a Millipore vacuum filtration unit through the wells. Following filtration, the residue is washed twice with 200 µl of 0.5% orthophosphoric acid. Once the filters have dried, 25 µl of Microscint 20 scintillant is added, and then counted on a Packard Topcount for 30 seconds.

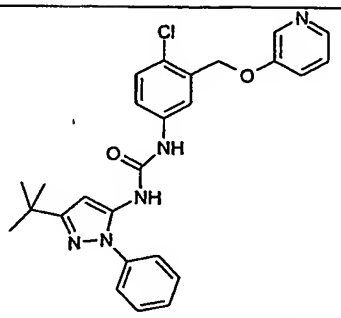
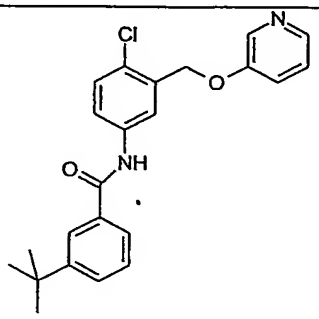
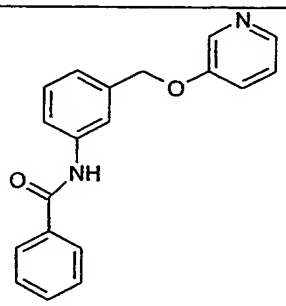
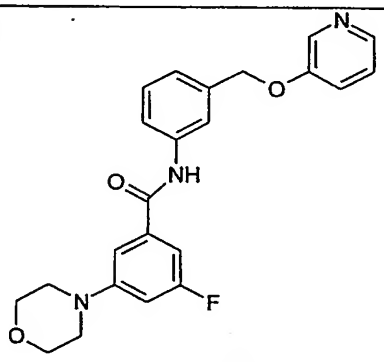
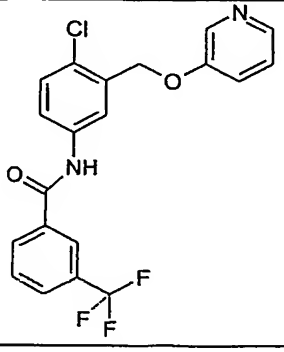
The % inhibition of the p38 activity is calculated and plotted in order to determine the concentration of test compound required to inhibit 50% of the p38 activity (IC_{50}) which is detailed in table 1.

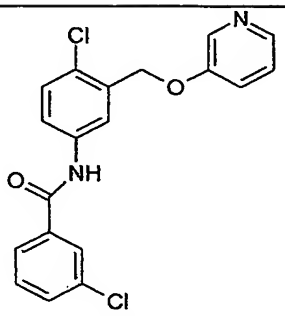
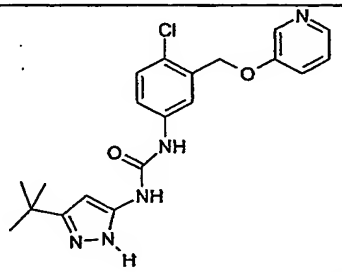
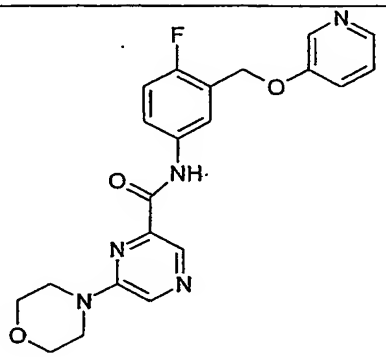
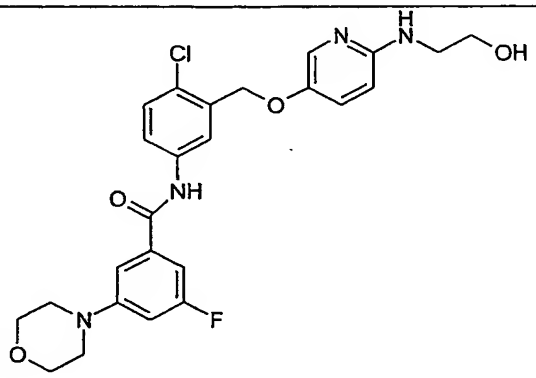
Table 1

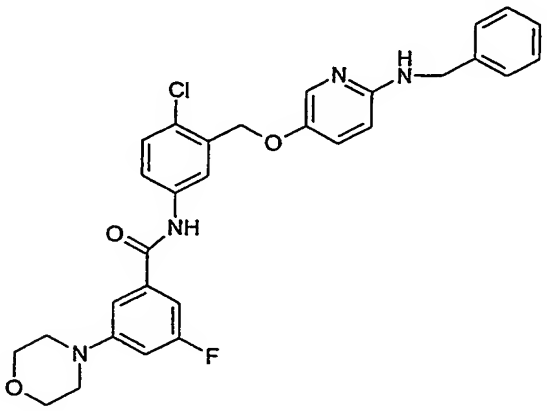
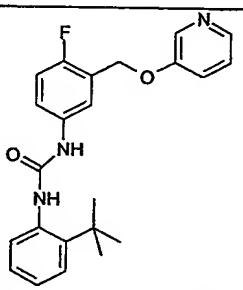
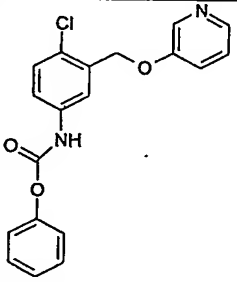
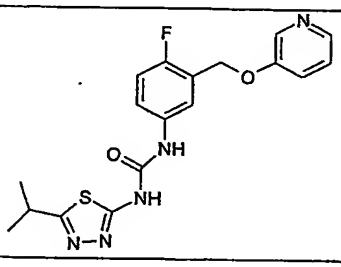
Compound	Structure	IC_{50} (µM)
1		<2

2		<2
3		<200
4		<20
5		<200
6		<20

7		<200
8		<200
9		<20
10		<2
11		<20

12		<2
13		<2
14		<200
15		<20
16		<20

17		<20
18		<2
19		<20
20		<2

21		<2
22		<20
23		<20
24		<20

Inhibition of LPS-Induced TNF-α Production in THP-1 Cells

The ability of the compounds of this invention to inhibit the TNF-α release was determined using a minor modification of the methods described in Rawlins P., *et al.*, "Inhibition of endotoxin-induced TNF-α production in macrophages by 5Z-7-*oxo*-zeaenol and other fungal resorcyclic acid lactones," *International J. of Immunopharmacology*, 21, 799, (1999).

THP-1 cells, human monocytic leukaemic cell line, ECACC) were maintained in culture medium [RPMI 1640 (Invitrogen) and 2mM L-Glutamine supplemented with 10% foetal bovine serum (Invitrogen)] at approximately 37°C in humidified 5% CO_2 in stationary culture.

THP-1 cells were suspended in culture medium containing 50ng/ml PMA (SIGMA), seeded into a 96-well tissue culture plate (IWAKI) at 1×10^5 cells/well (100µl/well) and incubated as described above for approximately 48 hours. The medium was then aspirated, the wells washed twice in Phosphate Buffered Saline and 1µg/ml LPS (SIGMA) in culture medium was added (200µl/well).

Test compounds were reconstituted in DMSO (SIGMA) and then diluted with the culture medium such that the final DMSO concentration was 0.1%. Twenty microlitre aliquots of test solution or medium only with DMSO (solvent control) were added to triplicate wells immediately following LPS addition, and incubated for 6 hours as described above. Culture supernatants were collected and the amount of human TNF-α present was determined by ELISA (R&D Systems) performed according to the manufacturer's instructions.

The IC_{50} was defined as the concentration of the test compound corresponding to half maximal inhibition of the control activity by non-linear regression analysis of their inhibition curves.

The IC_{50} values for Compound 2 and Compound 20 were found to be 170 nm and 970nM, respectively.